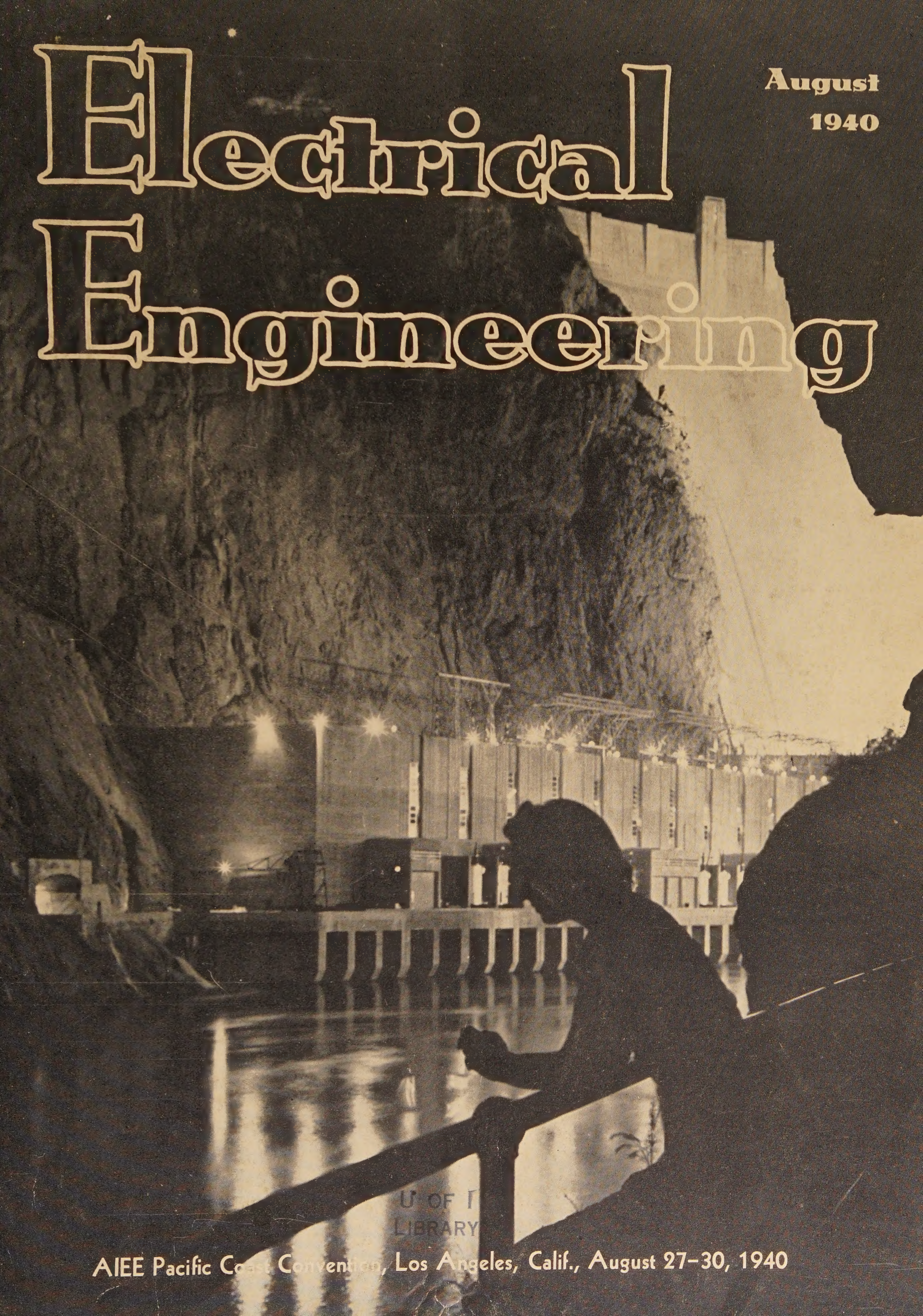
Electrical Engineering

August
1940



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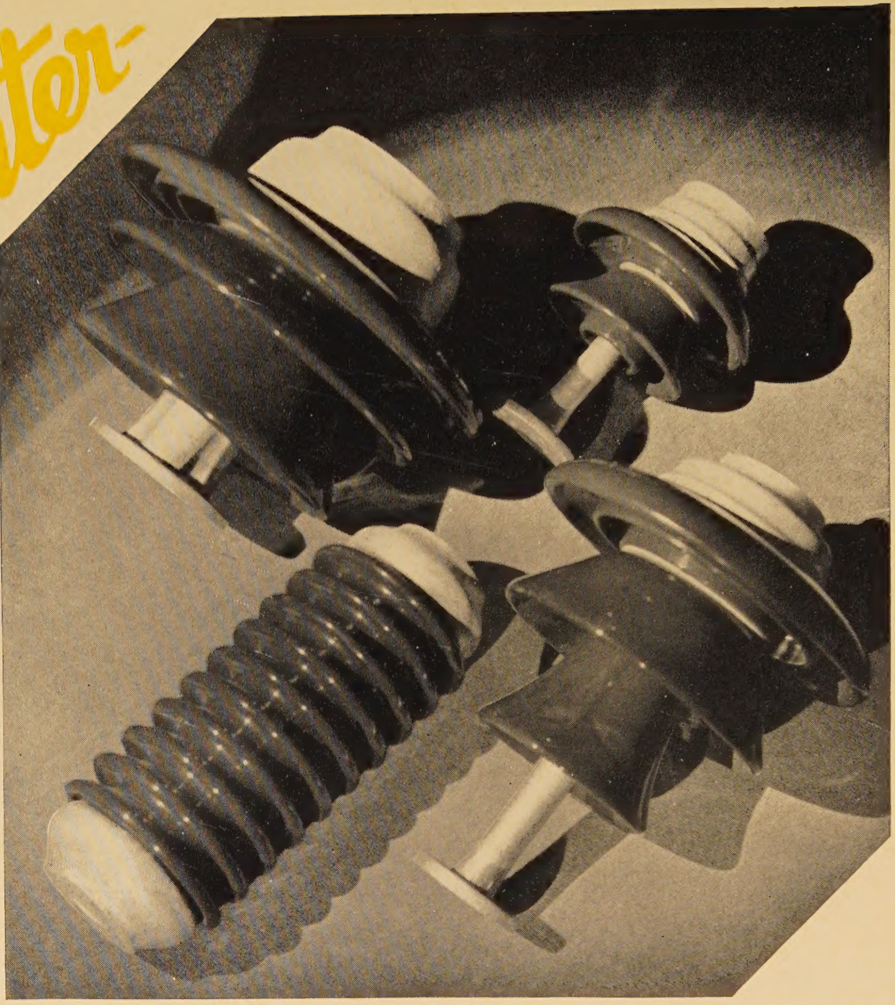
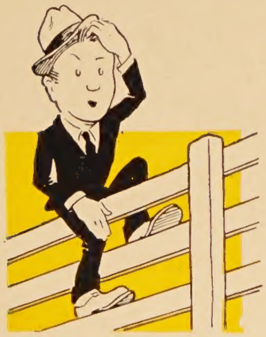
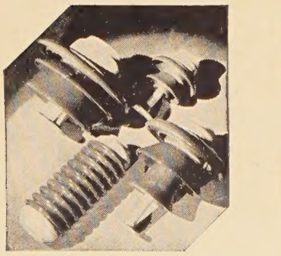
AIEE Pacific Coast Convention, Los Angeles, Calif., August 27–30, 1940

Here's a Good Pointer— on STATION INSULATION SELECTION





EVER BEEN "ON THE FENCE" on the kind of station insulators to specify? If so, you know that it is difficult sometimes to choose between conventional pincaps and station posts, even after carefully appraising the advantages of each type in terms of what they mean to the particular application being considered. For ordinary service conditions, one design cannot be said to be definitely superior to the other and that leaves the designer free to choose on the basis of appearance, matching existing units, or preference founded on past performance. Unusual service conditions may, however, indicate the importance of considering some characteristic in which one design or the other excels. As an aid in making the right selection, O-B has included a summary of the distinctive merits of each type in its new Switch and Bus Insulator Booklet. In addition to this summary the booklet tells how to judge insulators, shows all unit types on one panorama and gives detailed information on succeeding pages, an arrangement which greatly simplifies the selection procedure. And here's the good pointer—if you don't have one of these booklets, write for your copy today.



Ohio Brass (OB)

MANSFIELD, OHIO, U. S. A. 2140-H

Canadian Ohio Brass Co., Ltd., Niagara Falls, Ont., Canada

Electrical Engineering

Registered U. S. Patent Office

for August 1940—

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¶ Correspondence is invited on all controversial matters.

High Lights • •

Publication Policy. To improve the Institute's publication service to its members within prevailing budget limits, a series of proposals recommended by the publication committee, and endorsed by the conference of officers, delegates, and members at Swampscott, were approved by the board of directors at its summer-convention meeting. Certain of these proposals are effective with this issue of ELECTRICAL ENGINEERING; others will be placed in effect as rapidly as possible. Principal among the ultimate results to be achieved are the inclusion of more technical papers in ELECTRICAL ENGINEERING, and a very substantial reduction in the delay that has prevailed between presentation and publication of a technical program paper. Great credit is due to Chairman I. Melville Stein of the publication committee and to those who have worked with him (*pages 331–2*).

Watt-Hour Meters. The characteristics of watt-hour meters are dependent upon many diverse factors interrelated in a complex way. A type of load that may affect the registration of watt-hour meters is the mercury-arc power rectifier, which introduces harmonics in the current and voltage waves. Tests on 6- and 12-phase rectifiers indicate that the registration will be affected by less than one per cent (*Transactions pages 449–57*). On certain intermittent loads meters may have registration errors, the magnitudes of which are functions of meter design, periodicity of intermittent component of load, ratio of intermittent component to total load, character of intermittent component, power factor of load, and adjustment of the friction compensation. Prediction of registration characteristics may be made from acceleration and deceleration curves for the meter disk (*Transactions pages 460–4*).

Television. Although predictions that commercial television is "just around the corner", often heard during recent years, have failed to materialize, 3 stations now are broadcasting television programs on a regularly scheduled basis; 19 others have been licensed by the Federal Communications Commission, and applications for licenses for some 20 other transmitters have been filed with the Commission. In this issue, an authority on the subject reviews briefly the history, principles of operation, and present status of this new means of communication (*pages 313–22*).

Summer Convention. In addition to the general résumé of activities at the recent summer convention (*pages 333–5*), this issue includes a digest of the discussion at the annual conference of officers, delegates, and members (*pages 335–7*), a summary of the convention meeting of the board of directors (*page 340*), and reflections of the salient points discussed at the several informal technical conferences (*pages 337–40*).

Lightning. A co-operative field investigation of the lightning currents discharged by arresters at stations was undertaken in 1936; data so far obtained show large variations in the duty on arresters because of local conditions and seasonal changes (*Transactions pages 417–22*). An investigation of the effect of lightning on distribution systems indicates that arrester discharge currents of low magnitude and long duration may occur, and that such discharges are more likely to cause arrester failure than very high currents of short duration (*Transactions pages 442–9*).

Inductive Interference. Telegraph lines may have extraneous currents induced in them by power-supply and distribution systems that reduce the capacity and dependability of the lines. One method of control is the application of mitigative equipment to the telegraph system by which either a voltage to neutralize the interference is applied to the telegraph wires, or a combination of reactors and capacitors reduces extraneous sinusoidal currents by tuning (*Transactions pages 469–74*).

Motor Characteristics. The ability to obtain accurate characteristics of induction motors without actually measuring them is most desirable. In addition to the customary locked-rotor and no-load tests, two additional tests, a reverse-rotation test and an ordinary load run, provide data for calculating the characteristics (*Transactions pages 464–8*). Air-borne noise arising from an electric motor has as its principal source the vibration caused by the interaction of two large harmonic flux waves of slightly different space order and traveling at high frequency with respect to each other which cause high-frequency magnetic-force waves of long pitch (*Transactions pages 474–80*).

Transient Analysis. The method of symmetrical components may be used for the study of transients in symmetrical networks. The method is claimed to be readily applicable to all linear dynamical systems exhibiting this type of symmetry whether electrical or mechanical (*Transactions pages 457–9*).

Lamme Medal. Medal presentations frequently provide opportunity for interesting and stimulating backstage views of careers and personalities. The occasion of the presentation to Norman W. Storer of the Institute's 12th Lamme Medal during the summer convention at Swampscott, Mass., was no exception (*pages 322–5*).

Spark Gaps. A hitherto unrecognized factor responsible for the low impulse breakdown voltage of short enclosed spark gaps such as are used in lightning arresters has been found to be radiation from the region of the contact junctions between insulator and metal electrode (*Transactions pages 429–33*).

Water in Dielectric Liquids. Cellulosic insulation for high voltages must be maintained in a dry condition for successful operation. However, it may be brought to a hazardous condition in service by water absorption from the surrounding atmosphere through the insulating liquid (*Transactions pages 433–41*).

Electric Couplings. Electromagnetic forces may be used for transmitting torque, and couplings in marine service using these forces serve a threefold purpose by acting as a flexible coupling, as a disconnecting clutch, and as an aid in maneuvering (*Transactions pages 423–8*).

Current Transformers. Large errors of transformation may be expected of standard current transformers during the starting period when the current wave may be fully offset; actual performance must be determined if a suitable high-speed relay scheme is to be chosen (*Transactions pages 481–8*).

Pacific Coast Convention. The complete technical program and other details of the forthcoming Pacific Coast convention at Los Angeles, Calif., are included in this issue (*pages 332–3*).

Coming Soon. Among special articles and technical papers currently in preparation for early publication are: Two articles on the topic of transportation as a social problem as discussed at the recent summer convention in Swampscott, Mass., by Colonel William J. Wilgus in behalf of immediate government ownership and operation of American railroads, and by Colonel Robert F. Henry ardently in support of continued private enterprise; an article embracing the substance of the summer convention banquet address by L. A. Hawkins (A'03, M'13) vigorously urging engineers and scientists to bend and blend every possible effort toward the creation of the modern war materials and equipment necessary for adequate national defense; a paper describing a proposed method for the determination of current-transformer errors by G. Camilli (M'27) and R. L. Ten Broeck (A'29); papers on bushing-type current transformers by C. A. Woods, Jr. (A'37) and S. A. Bottonari (A'37), and J. P. Gebelein and J. A. Elzi (M'38); a paper discussing what wood may add to primary insulation for withstanding lightning by Joseph T. Lusignan, Jr. (M'34) and Charles J. Miller (A'32); papers on air circuit breakers by W. S. Edsall (M'19) and S. R. Stubbs; L. R. Ludwig (A'28) and R. H. Nau (A'40); L. R. Ludwig (A'28), H. L. Rawlins (A'30), and B. P. Baker (A'38); D. C. Prince (F'26), J. A. Henley, and W. K. Rankin; and H. E. Strang (M'40) and A. C. Boisseau; a paper on network coupling by means of static electronic frequency changers by Othmar K. Marti (F'39); papers on railway power supply by E. R. Hill (F'12) and Philip Torchio (F'12); and a paper on electric braking for railroad and urban transit equipment by F. H. Craton (M'38) and F. M. Turner

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TELEVISION

GEORGE R. TOWN
MEMBER AIEE

Television on a commercial basis similar to that of present-day radio-broadcasting has been predicted for some years, but experimental work has been costly and the technical problems involved in developing a satisfactory system have been extremely difficult. More recently, the problem of standardizing on a generally acceptable system has become an obstacle. The result has been that commercial television as commonly envisioned has been somewhat delayed. However, television broadcasts on a regularly scheduled basis began April 30, 1939, in connection with the opening ceremonies of the New York World's Fair, and now regular television programs are broadcast from 3 stations in the United States. Furthermore, 19 additional stations in 12 cities have been licensed by the Federal Communications Commission, and applications are pending for some 25 other transmitters in 18 cities. This activity, together with the increasing public interest in television, would seem to indicate that commercial television, at least in the urban centers, is not far off. The history of this new means of communication, its principles of operation, and its present status are reviewed briefly in this article.

TELEVISION is defined as the electrical transmission and reception of transient visual images. The word "electrical" excludes from the domain of television any completely optical device for viewing distant objects—for example, the telescope. The word "transient" implies that complete pictures are transmitted rapidly and excludes facsimile transmission where several minutes are required to send a single picture. In television, a complete picture is transmitted within the period of retentivity of the eye.

The history of television falls into three periods: fundamental discovery and invention, development, and realization.

PERIOD OF FUNDAMENTAL DISCOVERY AND INVENTION

Five fundamental devices are involved in successful television systems. The first of these depends upon the interaction of light and electricity. The variation in the resistance of a piece of selenium with incident illumination was discovered by May in 1873. This was followed by the discovery of the photoelectric effect by Hertz in 1887. Photoelectric cells, the basis of all television picture generators, were developed by Elster and Geitel between 1889 and 1913.

As early as 1879, Cary recognized that practical picture transmission can be accomplished only if the picture is divided into a number of small elements and the light values on each transmitted in rapid succession. This principle, known as scanning, was developed further by Nipkow, beginning in 1884. Although the Nipkow scanning disk is no longer used, scanning is as much a necessity in television today as in 1880.

The third important element needed in television transmission and reception is the vacuum tube. Important milestones in the development of this device were the discovery of the Edison effect in 1883, the invention of the two-element valve by Fleming in 1904, the introduction of the grid by DeForest in 1907, and the many important inventions of Armstrong. A specialized type of vacuum tube is the cathode-ray tube. Cathode rays were discovered by Pflucker in 1859, and the first practical cathode-ray tube was developed by Braun in 1897. The application of such tubes to picture reproduction was suggested by Rosing and by Campbell-Swinton in 1907.

The amplification of television signals requires an application of the theory of electrical networks and filters. Mention should be made of the work of Heaviside, Pupin, Kennelly, Campbell, and Carson in the period between 1887 and 1919 in the development of the network theory so essential in the design of circuits for television transmitters and receivers.

The final element needed in a television system is the transmission of energy by electromagnetic waves. Although pictures may be transmitted over short distances by means of wire facilities and over longer distances by use of concentric cables, economical television broadcasting necessarily involves the use of radio waves. Hence, the work of Maxwell, Hertz, and Marconi was a prerequisite to the development of television.

PERIOD OF DEVELOPMENT

All the fundamental elements involved in modern television were known by 1920, and it was about that date that the history of television entered its second phase—the period of development. Successful laboratory transmission of silhouettes was accomplished by Baird and by Jenkins in 1923, and in 1925 Baird transmitted half-tone pictures. The Bell Telephone Laboratories experimented with picture transmission between New York and Washington over wire lines in 1927. The year 1928 was notable in two respects. It saw the transatlantic transmission of pictures by Baird on a carrier frequency of approximately 6.7 megacycles, and the inauguration of television broadcasting by the General Electric Company's radio station WGY at Schenectady.

The development of television was greatly stimulated by the invention of two all-electronic picture pickup devices—the Farnsworth image dissector (1930) and the Zworykin Iconoscope (1933). The Bell Telephone Laboratories developed the scanning disk to a high degree of perfection and with it demonstrated high-quality picture transmission in 1937. However, the electronic pickup devices are so much more satisfactory from the standpoints of high sensitivity, high resolution, low cost, easy portability, and freedom from maintenance troubles that they have

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George R. Town is engineer in charge, television laboratory, Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y.

supplanted the scanning disk and other similar mechanical pickup systems.

The important part played in the development of television by the television committee of the Radio Manufacturers' Association must be mentioned. The contribution of this committee, which was organized in 1930, has been largely that of co-ordinating the work of the various television laboratories and setting standards of television transmission. The importance of television standards with respect to certain aspects of transmission cannot be overemphasized. Many methods are available for performing each of the many functions essential to a successful television system. Receivers designed to operate on certain types of transmission may be unable to receive pictures from stations operating on different principles. Hence, it is important that all television transmitters have certain features in common. In setting standards, the RMA television committee consistently refused to sanction systems that were capable of producing only low-definition pictures. Their guiding policy was that it would be much better to keep television in the laboratory until systems were developed which would produce pictures that would be satisfactory to the public. The RMA television standards were adopted by the association in the fall of 1938 after extensive laboratory and field tests.

The development of television in England followed a somewhat different course. The British Broadcasting Company began experimental television broadcasts in 1929. In 1935, a television transmitter was installed for the transmission of two types of television signals. Alternate broadcasts were sent by the Baird and Marconi television systems. After several months of operation, it was decided to standardize on the latter. Television programs were broadcast regularly from 1936 until the start of the war, when all public television service was suspended. These broadcasts were subsidized by the British Government. In setting television standards in the United States, full advantage was taken of British experience. The result was that many mistakes were avoided, and it is generally agreed that American television operates on a more satisfactory technical basis than does British.

PERIOD OF REALIZATION

With the adoption of RMA television standards in 1938, the television industry was ready to emerge into the period of realization. The situation at that time was aptly described by J. C. Wilson in his book "Television Engineering", when he stated, "The art has now reached a state in which an intelligent man might almost take an interest in it."

The year 1939 was well advertised as "the television year". Late in 1938, the National Broadcasting Company announced that it would broadcast by television the opening ceremonies of the New York World's Fair on April 30, 1939, and that thereafter it would maintain regularly scheduled television service in the New York area for public entertainment. This is quite different from experimental broadcasts at irregular intervals, and the April 30 program marked the true beginning of television service in the United States.

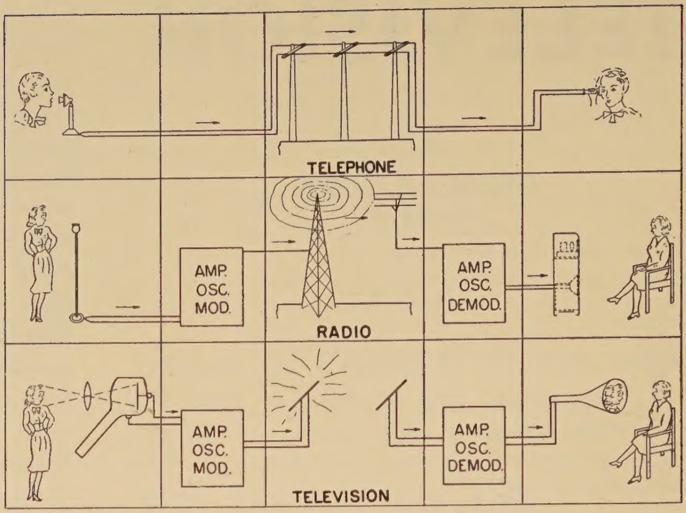


Figure 1. Three electrical communication systems

AMP.—Amplifier
OSC.—Oscillator
MOD.—Modulator
DEMOD.—Demodulator

Television was expected to experience a rapid growth. Manufacturers of television receivers were highly optimistic regarding public interest in television, and regarding the number of receivers that would be sold. The expectations regarding public interest have been fully realized, but in spite of this, the number of television receivers sold has been somewhat disappointing.

There are two chief reasons for the lack of greater public acceptance of television. The first of these is the price of the receivers. A high-quality television receiver, including in the same cabinet a good radio receiver, sells for approximately $600. It is quite probable that the price will be reduced in the next few years. However, the price reductions will not be on the scale that occurred with radio receivers. When radio receivers were first manufactured, they presented an entirely new production problem. The manufacturers had no previous experience with similar products. Hence, first prices were high. As production technique improved, manufacturing economies were effected, and large-scale price reductions resulted. In the television industry, the situation is quite different. Although it is considerably more complex, a television receiver has many features that greatly resemble those of a radio receiver. It uses many identical components. The same general assembly processes are used. The manufacturer of television receivers has behind him a background incomparably better than that of the pioneer radio-receiver manufacturer. Consequently, although price reductions certainly will occur, they will not be comparable with those of radio receivers.

That the public is interested in television receivers at a somewhat lower price level has been proved by a merchandising project undertaken by the Radio Corporation of America. This company offered television receivers for sale at prices approximately 34 per cent below list in Newburgh, Poughkeepsie, and Middletown, N. Y. During a three months' campaign, approximately 130 television receivers were sold. Comparing this with the fact that up to May 1, 1940, approximately 3,000 receivers had been sold in the entire New York area, it is evident that television receivers can be sold at prices not too far below the present level, provided intensive merchandising is employed.

Polls taken in the New York area have shown that the high price of television receivers is not the most important factor delaying the widespread purchase of receivers. The most important factor is the lack of satisfactory programs. The reason that high-quality programs are not available 18 hours a day from any television station is not difficult to find. It has been estimated that the cost of providing television programs 12 hours a week is between $500,000 and $2,000,000 a year, depending on the type of program material. All programs broadcast to date have been sustaining programs—that is, the cost has been borne by the station owner. One reason is that the Federal Communications Commission has not yet issued any commercial station licenses under which the station owner could charge for sponsored programs. However, even if such licenses had been issued, it is unlikely that many sponsored programs would have been produced. The cost of such programs is so high that sponsors would be reluctant to pay for them until they were assured that they would reach a large number of people. On the other hand, the public will not buy receivers until more programs are available. This situation makes it necessary for the television-station owner to provide the programs, and it is quite understandable that he should be reluctant to incur the great expense necessary to give a more satisfactory service.

This situation is certain to improve in the relatively near future. In many cities, more than one television station will be in operation soon. With rival stations competing for program material, both the quantity and quality of television broadcasts are certain to be more satisfactory. The resulting increase in the number of receivers in operation will result in commercial sponsorship of programs becoming more attractive to the advertising profession, when such sponsorship is allowed by the Federal Communications Commission.

Public acceptance of television in the United States closely parallels that which occurred in England where there was at first great public interest, but few immediate sales of receivers. The increase in the number of receivers in the hands of the public was slow but steady until the time of the coronation of King George VI. Parts of this event were broadcast by television, and the results were so remarkably good that intense public interest was aroused, and the sales curve for television receivers turned upward sharply. In this country, the television industry is now in the period of slow but steady growth. Some special event of great public interest some day will be televised with a similar result on sales. The fact that several television stations will be on the air soon will hasten the arrival of this event.

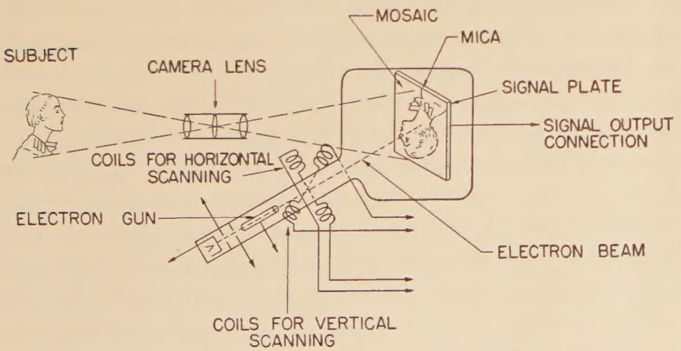


Figure 2. Television camera tube—Iconoscope

Operating Principles

All electrical communication systems perform three essential functions: conversion of information into electric energy, transmission of this energy, and reconversion of the electric energy into a replica of the original information. In telephony, sound energy is converted into electric energy at the transmitter. The generated signals are then sent over wires to the receiver where the electric energy is reconverted into sound. In radiobroadcasting, sound energy is converted into electric energy at the microphone. After suitable modification, this energy is radiated into space at the antenna. In this case, transmission of the energy involves the use of electromagnetic waves. At the receiver, these waves are picked up. After suitable modification, the electric energy is retransformed into sound at the loud-speaker.

In television, these same three essential operations must be performed. The light energy reflected from a picture is first converted into electric energy. This energy is then modified and is radiated by the transmitting antenna, as in radiobroadcasting. At the receiver, the energy is picked up, remodified, and finally transformed into a replica of the original picture.

PICTURE GENERATION

In photography, the image of a scene is focused on a photographic plate, and a chemical replica of the scene is formed on the plate due to photochemical effects. In television, the image of a scene is focused on the plate of a television-camera tube, and an electrical replica of the scene is formed due to the photoelectric effect. There are a number of different types of camera tubes, but it is sufficient to describe only one—the RCA Iconoscope.

The most important element in the Iconoscope is the image plate. This consists of a sheet of mica on the front side of which are deposited some 200 million minute cesium photoelectric cells. On the back side of the mica sheet is a metallic signal plate. Each cell is insulated from its neighboring cells and each element, in conjunction with the signal plate, forms a small capacitor. Because of its construction, the front side of the image plate is known as the mosaic. When a picture is focused on the mosaic, the photoemission of electrons takes place. These electrons are attracted to a positive collector ring, and in any given time each photoelement assumes a positive charge proportional to the incident illumination. Thus, the different light intensities in the picture are reproduced on the mosaic as variations in charge or in potential. In $^{1}/_{30}$ second, an element on which a strong light is falling assumes a potential approximately 1.5 volts positive with respect to an element in total darkness.

The remainder of the Iconoscope consists of means for transforming these space variations in potential over the surface of the mosaic into time variations in potential or into the "video" signal. This is accomplished by the process of scanning. An electron beam is generated in the electron-gun structure of the Iconoscope, and is moved rapidly across the plate in a series of nearly horizontal, parallel lines until the entire mosaic has been covered. When the electron beam strikes an element of the mosaic, it discharges the capacitor formed by the element and the signal plate, producing a current through the external load circuit. As the electron beam moves over the plate, it discharges each picture element in succession, producing currents instantaneously proportional to the charges on the various elements or to the incident illumination on these elements.

The motion of the electron beam in scanning is produced magnetically by means of currents in deflection coils. Two sets of coils are used, one to produce horizontal deflection of the beam, the other to cause vertical deflection. The deflection currents are approximately saw-toothed in shape with respect to time. Thus, the beam is moved across the mosaic at a uniform rate and is then returned quickly. The frequency of the currents in the horizontal deflection coils is 13,230 cycles while that of the currents in the vertical deflection coils is only 60 cycles. Thus, as the beam moves rapidly back and forth across the mosaic, it simultaneously moves slowly downward to cover the entire surface.

As soon as the mosaic is completely scanned, the electron beam returns to its starting point and repeats the scanning process. The mosaic is completely scanned in $^1/_{30}$ second. This is sufficiently rapid to produce the illusion of continuity of motion in the reproduced picture at the receiver, but is not fast enough to eliminate flicker. Flicker is eliminated by use of so-called interlaced scanning. Instead of scanning lines 1, 2, 3, 4, 5, 6 . . . in succession, lines 1, 3, 5 . . . are first scanned, then lines 2, 4, 6 . . . then 1, 3, 5 . . ., etc. The result is that the eye is fooled into thinking that it sees 60 pictures per second, and as a result no flicker is evident.

A very wide frequency signal band resultsf rom scanning. The minimum frequency is the frame frequency of 30 cycles. RMA television standards call for 441 scanning lines per picture, and for picture proportions of 4:3 aspect ratio (ratio of picture width to height). If a picture is divided into squares having sides equal to the distance between successive lines, 260,000 picture elements result. Each is scanned 30 times per second; or, 7,800,000 elements are traversed each second. The maximum signal frequency will be produced if alternate elements are black and white. Thus, the maximum frequency is nearly four megacycles. For good picture transmission a frequency band of four megacycles is required.

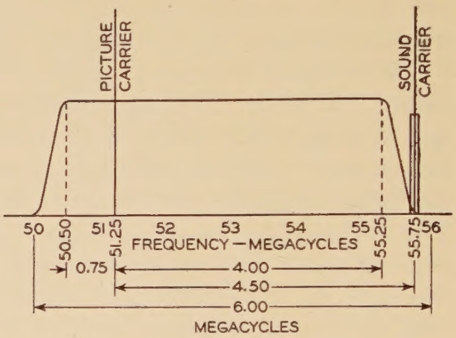
The video-frequency signals produced at the Iconoscope are treated in much the same manner that audio signals are treated in a radiobroadcast transmitter. They are amplified, used to modulate a carrier signal, and amplified further in a more or less conventional manner. Two important differences do exist. Since the video-frequency band is so wide, a television channel occupies considerable space in the electromagnetic spectrum. If double-side-band transmission were employed, a channel more than eight megacycles wide would be required. By transmitting only part of one side band, the channel width may be reduced to six megacycles, thus effecting considerable saving. Standard transmission-channel characteristics are shown in figure 3.

The high video frequencies necessitate much higher carrier frequencies than those required by sound broadcasting. The Federal Communications Commission has assigned 18 channels for television use. Of these, only the first 7 will be used in the immediate future for television-broadcast service. These channels are 50–56, 60–66, 66–72, 78–84, 84–90, 96–102, and 102–108 megacycles.*

TRANSMISSION

The electromagnetic waves used in television transmission differ from those used in normal broadcasting only in frequency (or wave length). However, this difference results in significant differences in transmission characteristics. The antennas used in television are much smaller than those used at lower frequencies. For reception, a simple dipole—two rods each one-quarter wave length long placed end to end—is sufficient for most installations. For the first television channel, the over-all length of such a structure is only ten feet. For transmission, more complex structures are used in order to obtain better impedance and directional characteristics. However, their dimensions are approximately the same as those of receiving antennas.

Figure 3. Typical television - transmitter amplitude characteristics



An important characteristic of high-frequency waves is their approximately straight-line propagation. In this, they somewhat resemble the much shorter light waves. Shadows are cast by large buildings and by mountain ranges, though there is some diffraction over the edges of such obstacles. A more important result is the limitation of range due to the horizon effect. Since the waves do not bend greatly at the horizon, the range of a television transmitter is limited to approximately the distance one can see from the transmitting antenna. This, of course, is the reason for placing television transmitting antennas at high elevations—for example, on top of the Empire State and Chrysler Buildings in New York City, and the Helderberg

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* The 44–50 megacycle channel now being used by some television transmitters will be used for frequency-modulation radiobroadcasting in the near future.

Mountains near Schenectady, N. Y. It should be noted that there is no sharp cutoff at the horizon. Up to a distance of approximately 15 per cent greater than the optical range, the field strength varies inversely as the square of the distance from the transmitting antenna. Beyond this distance, the field strength varies inversely as the third to fifth power of the distance, the exponent depending on the frequency.

Another important result of the quasi-optical nature of television transmission is the reflection of the waves from large vertical surfaces. Because of such reflections, waves may arrive at the receiver by more than one path. Any reflected path is longer than the direct path, and as a consequence reflected signals arrive later than direct signals. The result is the production of multiple images or echo pictures at the receiver. A difference in path lengths of 800 feet produces a displacement of the received pictures of $^1/_8$ inch on a 12-inch picture tube. The remedy for these echo effects is proper orientation of the receiving antenna or, if necessary, more elaborate receiving-antenna systems.

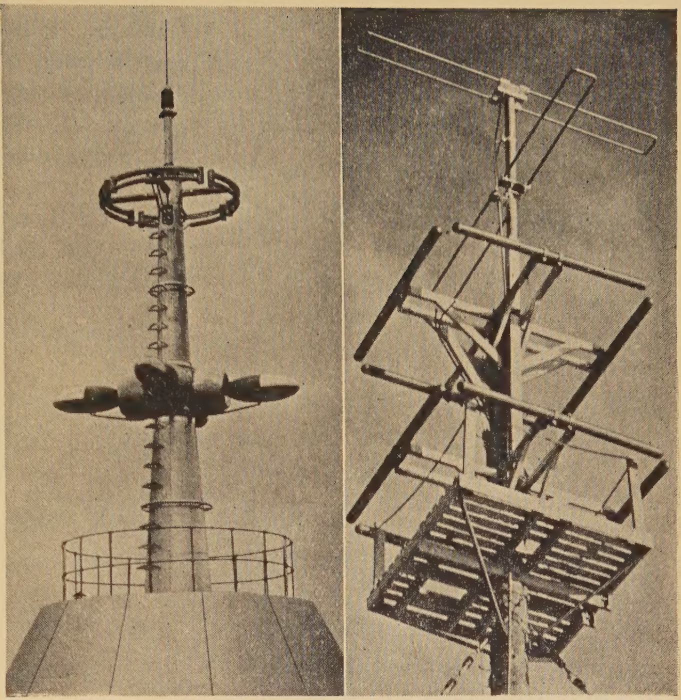
Television transmitters and receivers are connected to their respective antennas by means of transmission lines. If these lines are not properly terminated, reflections occur. The result is the production of echoes similar to those caused by multipath transmission.

The problem of interference is quite different from what it is on the standard broadcast band. True static interference does not exist. However, interference from automobile ignition systems and from the diathermy machines used by physicians is frequently very annoying. Television antennas are horizontally polarized to minimize ignition interference. No true fading exists, but a similar effect due to irregular reflections from moving objects, such as trucks or airplanes, may occur.

PICTURE REPRODUCTION

The first portion of a television receiver is quite similar to the corresponding portion of a radiobroadcast receiver. The superheterodyne circuit is used almost exclusively in the United States. The function of the first portion of the receiver is to convert the received waves into a replica of the video signal produced at the camera tube by means of amplifiers, modulators, demodulators, etc. The video signal is converted into a picture by means of the picture tube. A typical picture tube or Kinescope (RCA designation) is shown in figure 7. This is essentially a high-grade cathode-ray tube with a grid for controlling the beam current. The light produced at the fluorescent screen upon the impact of the electron beam depends upon the beam current. Hence, to reproduce the transmitted picture, it is only necessary to move the electron beam in the Kinescope in synchronism with the beam at the Iconoscope and use the received video-signal voltage to control the beam current.

The process of picture reproduction may be compared with that of painting a design on the side of a clapboarded house with a paint spray gun. Each board is painted in succession by moving the gun at a uniform rate along its length from left to right. By controlling the pressure on the trigger of the gun, the amount of paint applied to any section of a board may be controlled. By exercising proper control of the trigger at all points along each board, any desired design may be painted.


Courtesy NBC

Courtesy General Electric

Figure 4. Typical television-transmitter antennas: left—sound and picture antennas of W2XBS atop the Empire State Building in New York City; right—combined frequency-modulation and television-sound antenna of W2XB in the Helderberg Mountains near Schenectady, N. Y.

Referring again to the picture tube, the electron beam is moved back and forth across the fluorescent screen in step with the electron beam in the Iconoscope at the transmitter; or, the fluorescent screen is scanned by the electron beam. The scanning is usually accomplished magnetically by saw-tooth currents in deflection coils as in the Iconoscope, although in small-diameter picture tubes electrostatic deflection by means of saw-tooth voltages applied to deflection plates is sometimes used. The number of electrons reaching any point of the fluorescent screen (and thus the brightness of that point of the screen) is controlled by means of voltages applied to the grid of the picture tube, as in a conventional vacuum tube. The grid voltage thus corresponds to pressure on the trigger of the paint gun.

The process of transmission of one element of a picture from Iconoscope to picture tube will now be traced briefly. Assume that the illumination of this element of the mosaic is high, corresponding to a high light in the picture. This section of the mosaic accumulates a positive charge due to the emission of photoelectrons. At the instant under consideration, the Iconoscope electron beam strikes this element and discharges it, producing a certain current in the Iconoscope output circuit and a positive voltage across a resistor in this (or in an associated) circuit. After amplification, modulation, transmission, amplifica-

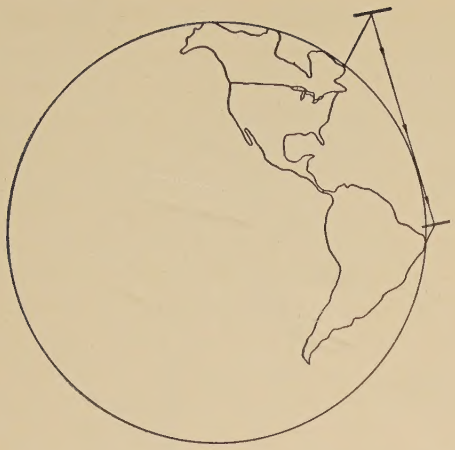


Figure 5. Horizon limitation of ultrahigh - frequency - wave propagation

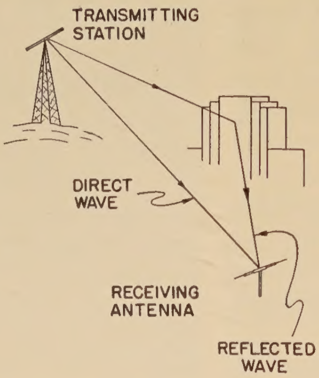


Figure 6. Direct and reflected transmission paths

tion, and detection, this positive voltage reappears on the grid of the picture tube. Circuits are so arranged that at this time, the electron beam in the picture tube strikes the screen at a position corresponding to that of the element of the mosaic under consideration. The positive voltage applied to the grid results in high beam current and a bright spot at the fluorescent screen. As the electron beams in the Iconoscope and picture tube move on together, the Iconoscope beam eventually reaches a picture element where very little light is falling. The resulting positive voltage in the Iconoscope output circuit is smaller than before. This reduced positive voltage appears on the grid of the picture tube, decreasing the beam current and producing a dark area at the screen. The process continues and the entire picture is reproduced, element by element.

SYNCHRONIZING CHANNEL

It is evident that successful picture reproduction depends on keeping the motions of the electron beams at the camera tube and the picture tube synchronized. Otherwise the received picture will be hopelessly jumbled. This important function is performed by synchronizing signals which are transmitted along with the video or picture signals. They occur only during the retrace or return periods when the electron beam moves rapidly back from right to left or from bottom to top of the picture. The polarity and magnitude of these synchronizing signal voltages are such that they correspond to a fictitious light intensity more black than that corresponding to no light incident on the mosaic; or they are "blacker than black". Thus, the grid of the picture tube is driven more negative than the black level by the synchronizing signals, and these signals produce no extraneous picture. Since the synchronizing signals lie outside the voltage range used to represent light intensity, they can be separated from the picture signals by means of amplitude discriminating circuits and fed to the synchronizing circuits where they control the frequencies of the currents in the deflection coils. Two sets of synchronizing signals are used—one for horizontal deflection and one for vertical deflection. The two sets of synchronizing pulses differ from each other in duration and are usually separated from each other by differentiating and integrating circuits. Figure 8 shows a portion of a typical composite signal consisting of video and synchronizing signals.

SOUND CHANNEL

Every television picture transmitter has associated with it a complete radiobroadcasting station to transmit the accompanying sound. Likewise, every complete television receiver has a sound channel to receive this sound. The circuits are arranged so that both picture and sound channels are tuned simultaneously.

Since plenty of frequency space is available, the sound channel is always of high fidelity. The high audio frequencies are pre-emphasized at the transmitter, allowing a drooping frequency characteristic at the receiver. The result is that the increase in noise due to high-fidelity operation is much less than normal.

A complete television system embodying picture, synchronizing, and sound channels is indicated in figure 9.

Some Common Questions

There are a number of questions that are commonly asked regarding television. Some of these already have been discussed. Others are considered in succeeding paragraphs.

RANGE

The limitation of consistently good television service to an area having a radius not greatly exceeding the optical range from the transmitting antenna is of a fundamental nature, since it depends upon the properties of high-frequency electromagnetic waves. There seem to be only two possibilities of extending the range. The first of these is the use of frequency-modulated transmitters. Although the field strength of frequency-modulated waves varies with distance from the transmitter in the same manner as does that of amplitude-modulated waves, the useful range is greater because a much lower signal-to-noise ratio is required, and hence reception is possible with lower signal strengths.

The second possibility is the development of some radically different method of picture transmission which might conceivably be used over longer distances. No such development is in prospect at the present time.

It may be concluded that the range of consistent television transmission is definitely limited. Even the use of frequency modulation would not greatly increase the range. Hence, for some time to come, television service will be confined to areas within, say, 30 to 60 miles from transmitters. These transmitters will be located only near large centers of population.

Transmission over greater distances is always the result of either very elaborate receiving systems or freak conditions. At the General Electric Company station W2XB near Schenectady, N. Y., pictures from W2XBS in New York are consistently received. However, the receiving antenna is a large rhombic antenna located in the Helderberg Mountains at a height of 1,828 feet above sea level. Such facilities, of course, are far superior to those available to the average owner of a television receiver. Pictures from the London television transmitter have been received on Long Island, N. Y., by the Radio Corporation of America. This, however, is a case of freak transmission which cannot be relied upon for regular reception. Such freak transmissions, however, may cause annoying interference with reception from nearby stations.

CHAIN TELEVISION BROADCASTING

It is probable that in the relatively near future, television stations will be linked into networks comparable to present-day radiobroadcasting networks. However, the method of connecting the various stations will be much different.

Because of the wide frequency band required for transmission of high-quality television pictures, telephone lines are suitable only for extremely short-distance transmission and then only with the use of elaborate correction networks. The transmission loss over one mile of telephone distribution cable increases from 25 decibels at 0.5 megacycles to 68 decibels at 3 megacycles. Moreover, the phase characteristics are far different from the desired linear variation of phase shift with frequency. Transmission has been accomplished over distances of approximately a mile, but long-distance transmission is highly improbable.

Coaxial cable may be employed to link television transmitters, but its cost is prohibitive when long distances are to be covered. The solution of the problem is the use of ultrahigh-frequency television transmitters as relay stations. These will be located every 30 or 50 miles along the desired route and will probably consist of a receiving antenna, amplifier, and transmitting antenna. The stations will be entirely unattended. Carrier frequencies of several hundred megacycles will be used. Preliminary tests have shown that such relay stations are entirely practicable.

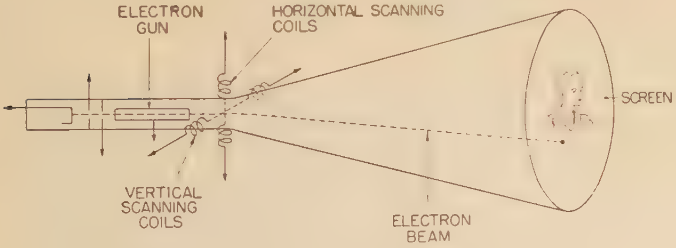


Figure 7. Television picture tube—Kinescope

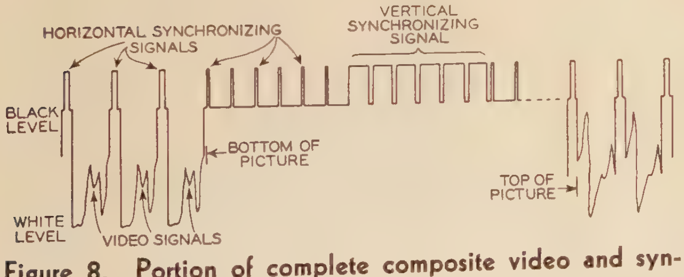


Figure 8. Portion of complete composite video and synchronizing signal at bottom of picture

TELEVISION RECEIVERS

Three classes of receivers are recognized in the television industry. A "picture receiver" will receive pictures only and has no facilities for receiving the associated sound. A "picture receiver with sound converter" has, in addition, an incomplete sound channel requiring the use of an auxiliary sound receiver. A "television receiver" has complete channels for both the picture and the associated sound. Expensive television receivers usually have included in the same cabinet a complete radio receiver.

The diameter of the picture tube determines the picture size. At present, receivers are available with tubes having diameters of 5, 7, 9, 12, and 14 inches. The ratio of picture-tube screen diameter to picture width to picture height is 5:4:3. Large diameter tubes are usually quite long, and it is awkward to build cabinets of the depth required to accommodate them in a horizontal position. Hence, such tubes often are mounted vertically and the picture is viewed in an inclined mirror. Smaller tubes are mounted horizontally for direct viewing.

The operation of a television receiver is not particularly complex. Station selection usually is accomplished by means of push buttons. In addition, a vernier tuning control often is provided. When this is tuned for maximum sound, the picture automatically is tuned correctly. Contrast and brightness controls allow the user to adjust the gain of the receiver and the average brightness of the picture. Other picture channel controls do not have to be adjusted frequently and are often located where they are easily available to the service man, but not to the user. The controls on the sound channel are the same as on ordinary radio receivers.

COST AND OBSOLESCENCE OF RECEIVERS

In considering possible price reductions in television receivers, a brief study of prices in England is instructive. Prices of English and American receivers are listed in

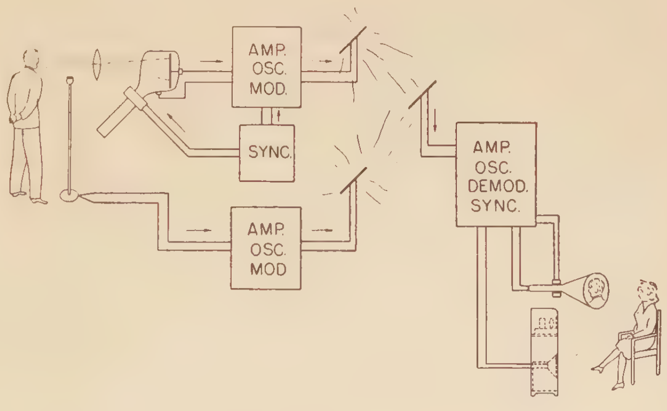


Figure 9. Complete television system

AMP.—Amplifier
OSC.—Oscillator
MOD.—Modulator
DEMOD.—Demodulator
SYNC.—Synchronizer

Table I. Prices of English and American Television Receivers

Country	Year	Price (Dollars Per Inch of Diameter of Picture Tube)
England	Fall, 1936	35 to 44
	Fall, 1937	21 to 37
	Fall, 1938	20 to 37
	Fall, 1939	16 to 21
United States of America	Summer, 1939	40 to 50

table I. Since the price of a television receiver is largely a function of the diameter of the picture tube, the prices are given in dollars per inch of diameter of that tube. It may be seen that in three years, English receivers were reduced in price approximately 50 per cent.

Prices in America may always be higher than in England. In America, receivers must be built to receive several stations, while in England the government monopoly of communications prevents the establishment of more than one station in any locality. English standards limit the maximum detail available in a picture to a lower value than do the standards in the United States, with the result that certain economies can be effected in English receivers which cannot be made in American receivers.

The question of obsolescence of receivers is closely related to the matter of television standards of transmission. The present RMA television standards provide satisfactory television service. This, however, is no reason for arguing that the art must stagnate at its present level. Such improvements as can be justified from engineering and economic standpoints should be introduced. The Federal Communications Commission, while recognizing the value of the present standards, has steadfastly refused to approve them as the final answer to all the problems of television broadcasting.

One direction in which the art may progress is toward greater picture detail. The present RMA standards provide an admittedly sufficient amount of detail in pictures produced on 12-inch tubes. There is a feeling among some in the industry that this detail will not be sufficient when larger pictures are viewed at close range. The maximum detail is a function of the number of scanning lines per picture. The detail cannot be increased without the production of higher video frequencies unless fewer pictures per second are transmitted. Both of these are undesirable as they result in a higher frequency band and more flicker, respectively. If flicker can be overcome (for example, by advances in the preparation of fluorescent screens), it may be feasible to increase the number of lines and hence to improve picture detail without increasing the video band width. Systems have been proposed whereby such improvements in picture structure can be made without involving great changes in present receivers. The practicability of the entire scheme depends on future improvements in the properties of the picture screen.

The possible application of frequency modulation to television already has been mentioned. Various proposed television systems employ frequency modulation for the sound channel, for the synchronizing channel, for the picture channel, and for all channels. Such systems might have advantages over amplitude-modulation systems other than improved freedom from noise. In sound broadcasting, a deviation ratio (maximum excursion of carrier frequency to maximum modulating frequency) of five to one seems desirable. This would require a total band width of 40 megacycles for television broadcasting using a maximum video frequency of 4 megacycles. This, of course, is prohibitive except at extreme ultrahigh carrier frequencies. The alternative is to use a lower deviation ratio, say one to one. Whether the full advantages of frequency modulation are obtained with low deviation ratios is a matter upon which agreement has not been reached. It is probable that amplitude modulation will be retained on the first seven television channels. When carrier frequencies above 150 megacycles are used for television broadcasting, it is quite probable that frequency modulation will be employed. This probably will not occur for several years.

LARGE PICTURES

The diameter of the picture-tube screen cannot be increased indefinitely because of mechanical limitations. An experimental picture tube having a diameter of 31 inches was once constructed by RCA. This tube was $4^1/_2$ feet long. A convex Pyrex face, two inches thick, was required to withstand the five tons of atmospheric force. Such a tube obviously is unsuited for home use.

The practical production of large pictures necessarily involves some projection scheme. The principal problem is the production of a picture of such high brightness that the brightness of the enlarged projected picture will be satisfactory. Motion-picture practice aims at a screen brightness of approximately 3.5 candles per square foot, although 1.5 candles per square foot is about the present average. The brightness of the high lights in directly viewed television picture tubes is approximately 6 candles per square foot. Hence, these do not permit of much enlargement.

Four types of projection equipment offer promise. The first employs a somewhat conventional small-diameter

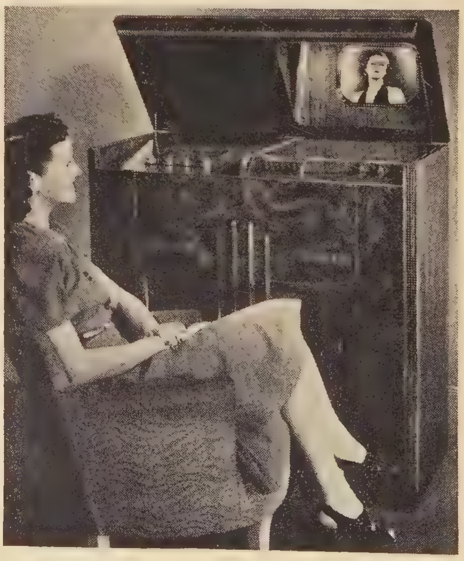


Figure 10. Typical television receiver

picture tube operated at very high second-anode voltage. The chief difficulties are with screen life and in the electron optics involved in the design of an electron-gun structure to produce a sufficiently fine electron beam. A projection lens is employed to enlarge the picture. Screen brightnesses of the order of one candle per square foot on a screen ten feet wide have been obtained.

The second type of projection equipment is that developed in England by Scophony. This employs an entirely different type of equipment involving mechanical elements rotating at high speed and a supersonic light valve (*EE April '40, p. 151*). Other proposed projection systems employ intermediate motion-picture film and special types of thermally or electrically sensitive picture-tube screens. These systems have not yet proved practicable.

No American manufacturer has yet placed projection-type receivers on the market. However, they may be available within the next few months. Projection equipment, of course, is necessary if television is ever to be shown in theaters. Such television service would doubtless be of a supplementary nature only, offering theater patrons the facilities for viewing news or sports events of special interest.

PICTURE COLOR

Television pictures are produced in black and white only. All picture-tube screens are not the same and the "white" may be slightly off on the yellow (warm) or blue (cold) side. Television systems for showing pictures in natural colors have been the subject of many patents, and of some laboratory investigation. The introduction of any natural-color system into practical television broadcasting lies far in the future.

PROGRAMS

In New York City, station W2XBS broadcasts television programs approximately 15 hours a week. A great variety of programs has been produced. These include drama, opera, variety shows, news comments, fashion shows, art-appreciation programs, hobby exhibits, puppet shows, ballet performances, cooking demonstrations, etc. Special news events are often broadcast. For example, the visit of the King and Queen of England to the United States was well covered. Sporting events of many kinds have been transmitted. These include baseball, football, basketball, tennis, horse racing, hockey, boxing, and wrestling. It has been remarked that if the best seat in a football stadium sells for $3.30, the television picture is the equivalent of a $1.65 seat.

In radiobroadcasting, many programs are presented by means of recordings or electrical transcriptions. Motion pictures are the analogous subject matter in television, with newsreels and cartoons being the most popular presentations. Special equipment is required at the transmitter to compensate for the different frame frequencies used in motion pictures and television (24 and 30 frames per second).

For remote pickups, as used for special news events, sports, etc., a complete portable television transmitter is taken to the desired location. It transmits the program on an ultrahigh-frequency link, usually 156 to 162 megacycles, to the main studio where the program is received, monitored, and rebroadcast.

MISCELLANEOUS USES OF TELEVISION

The chief use of television is for entertainment. However, other applications may be of great future importance. For example, the educational possibilities of television, especially in the field of art, must not be overlooked. In many cities, instruction via radio is a regular feature of

Table II. Licensed Television Transmitters

Location	Call Letters	Owner
Broadcasting on Regular Schedule		
New York, N. Y.	W2XBS	National Broadcasting Company
Chicago, Ill.	W9XZY	Zenith Radio Corporation
Los Angeles, Calif.	W6XAO	Don Lee Broadcasting System
Broadcasting Experimentally		
New York, N. Y.	W2XAB	Columbia Broadcasting System
Passaic, N. J.	W2XVT	Allen B. DuMont Laboratories
Helderberg Mountains near Schenectady, N. Y.	W2XB	General Electric Company
Philadelphia, Pa.	W3XE	Philco Radio and Television Corporation
Under Construction or Design		
Boston, Mass.	W1XG	General Television Corporation
Bridgeport, Conn.	W1XA	General Electric Company
New York, N. Y.	W2XWV	Allen B. DuMont Laboratories
Long Island City, N. Y.	W2XDR	Radio Pictures
Camden, N. J.	W3XEP	RCA Manufacturing Company
Iowa City, Ia.	W9XUI	State University of Iowa
Kansas City, Mo.	W9XAL	First National Television
Ultrahigh-Frequency Stations		
New York, N. Y.	W10XKT	Allen B. DuMont Laboratories
New York, N. Y. and Camden, N. J. (portable)	W2XBT	National Broadcasting Company
Camden, N. J. (portable)	W3XAD	RCA Manufacturing Company
Philadelphia, Pa.	W3XP	Philco Radio and Television Corporation
Schenectady, N. Y.	W2XH	General Electric Company
Los Angeles, Calif.	W6XDU	Don Lee Broadcasting System
Low-Definition Experimental Stations		
West Lafayette, Ind.	W9XG	Purdue University
Iowa City, Ia.	W9XK	State University of Iowa

Table III. Television-Station License Applicants

Location	Applicant
Boston, Mass.	Boston Edison Company
Springfield, Mass.	Henry Walczak
Avon, Conn.	Travelers Broadcasting Company
Meriden, Conn.	WDRC, Inc.
New York, N. Y.	Columbia Broadcasting System
	Bamberger Broadcasting Service
	Metropolitan Television (Bloomingdale Brothers and Abraham and Straus, department stores)
Philadelphia, Pa.	National Broadcasting Company
	WCAU
Washington, D. C.	National Broadcasting Company
	Allen B. DuMont Laboratories
Cincinnati, Ohio	Crosley Radio Corporation
Fort Wayne, Ind.	Farnsworth Television Corporation
Chicago, Ill.	National Broadcasting Company
	Balaban and Katz
Milwaukee, Wis.	Milwaukee Journal
St. Paul, Minn.	KSTP, Inc.
Des Moines, Iowa	R. B. Eaton
Kansas City, Mo.	Midland Broadcasting Service
Manhattan, Kans.	Kansas State College
North Sacramento, Calif.	Grant Union High School
San Francisco, Calif.	Don Lee Broadcasting System
	Hughes Tool Company
Los Angeles, Calif.	Earle G. Anthony, Inc.
	Hughes Tool Company
	Leroy's Jewelers
	May Department Stores
	Television Productions

public school work. This work could be greatly expanded by the use of television.

Television is undoubtedly of military value. The recent feat of the National Broadcasting Company of broadcasting a television program originating in portable transmitting equipment carried in a moving airplane indicates possible military uses.

Science doubtless will find television a valuable tool. Mention must be made of recent studies of the corona of the sun, which were made possible only by the application of the principles of television.

PRESENT STATUS OF TELEVISION BROADCASTING

At the present time, only three television stations are providing regularly scheduled entertainment programs. These are W2XBS in New York, W9XZY in Chicago, and W6XAO in Los Angeles. This last station has been broadcasting television programs since 1933, but has been operating on an experimental basis until recently. In addition to these stations, 19 others in 12 cities have been licensed by the Federal Communications Commission. All licensed stations are listed in table II in which the status of each station is indicated. Applications for licenses for at least 28 other television transmitters in 20 cities have been filed before the Commission. These are listed in table III.

Several licensed stations are preparing to broadcast commercially sponsored programs. This matter has been the subject of heated debate before the Federal Communications Commission, which announced on February 29, 1940, that limited commercial sponsorship would be allowed after September 1 and then, on March 23, rescinded this order and held further hearings. On May 28, the Commission ruled that for the present, all television transmitting stations should confine their activities to research and development work and should not proceed with plans for immediate expansion of program service. This ruling is subject to review in the fall of 1940. This action of the Commission will delay the extension of public television service, but may possibly result in the industry building on a basis that will prove to be more permanently satisfactory.

Norman W. Storer—1939 Lamme Medalist

"For meritorious achievement in the development of apparatus and machinery for electrical transportation"

THE AIEE Lamme Medal for 1939 was presented during the Institute's recent summer convention at Swampscott, Mass., to Norman W. Storer (A'95, F'13) retired consulting railway engineer of the Westinghouse Electric and Manufacturing Company.

Opening the presentation ceremonies Doctor W. B. Kouwenhoven (A'06, F'34) chairman of the Lamme Medal committee, said:

"This year marks the 12th presentation of the Lamme Medal. It is interesting to note that the first award of the Lamme Medal was made at Swampscott on June 26, 1929, almost 11 years ago to the day. The medalist of that year was Allan B. Field. It is also of significance that the man who at that initial presentation of the medal gave a sketch of Mr. Lamme's career is the man whom we are gathered to honor on this occasion.

"Mr. Lamme, the founder of the medal, was born on an Ohio farm in 1864. He had a natural bent for mechanical devices and was fascinated by mathematics. He graduated from Ohio State University in 1888 and in the following year began his work in the test department of the Westinghouse Electric and Manufacturing Company. In 1924, when he died, he was its chief engineer.

"His vast contributions to the design and development of electrical machinery are marked by his inspirational force and his achievements as the guiding genius of the company with which he was associated. Mr. Lamme possessed a brilliant mind. His industry, his courage and his imagination were outstanding. He was a pioneer in a field in which little was known. He was interested in young men and their further education after leaving college. He was a great man of broad vision.

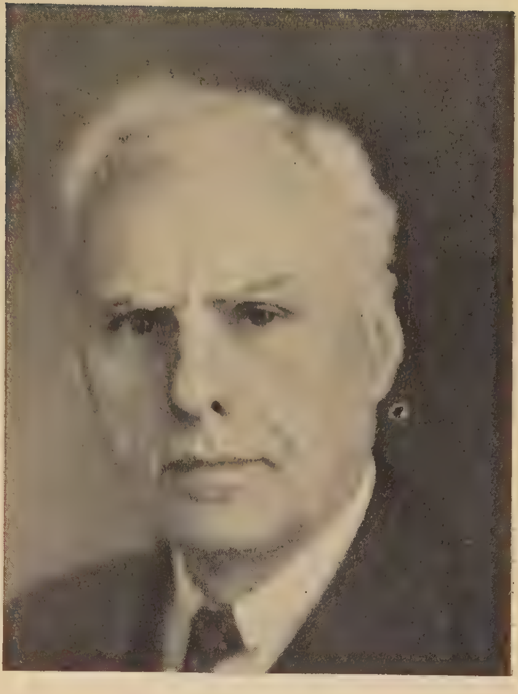
"He realized the need for inspiration and incentive and in his will established three medals. One, at Ohio State University, is awarded "for meritorious achievement in engineering or the technical arts". It is of interest to note that Mr. Storer received the Ohio State Lamme medal in 1933. The second is awarded by the Society for Promotion of Engineering Education, "for accomplishments in technical teaching or actual advancement of the art of technical training". The third is the AIEE medal, "for meritorious achievement in the development of electrical apparatus or machinery."

"It is the Lamme Medal of the Institute that we are awarding today. This medal will continue to serve as an inspiration and as a guiding star to the engineers of the future."

Medalist Storer's career was reviewed by Doctor A. M. Dudley (A'08, F'13) Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., after which President F. Malcolm Farmer made the presentation. Essential substance of Doctor Dudley's informal remarks and of Mr. Storer's response, as recorded at the meeting, follows.

N. W. Storer—A Personal Tribute

A. M. DUDLEY, Fellow AIEE



Norman Wilson Storer

In the very fertile country of the great nation of the Buckeye, where the sweeping curve of Lake Erie cuts across the western boundary line of Pennsylvania, the county in Ohio is Ashtabula, the most northeastern county. Just below Ashtabula is Trumbull County; and in a little town on the edge of Pennsylvania called Orangeville, Norman W. Storer was born. This little town is so situated that when you retire at night you can hang your clothes in Ohio and go to bed in Pennsylvania if you so desire.

It has not been told us whether Mr. Storer climbed any telegraph poles when he was young, or what he did, but we have it on good authority that he got through the public-school system of Ohio and went to Ohio State University, where in 1891 he graduated with the degree of mechanical engineer in electrical engineering. That degree has not been hailed with joy by either electrical or mechanical engineers, but in this case it was distinctly prophetic, because the work which Mr. Storer has done, the marvelous engineering job, has been quite as much, I think, on the side of mechanical engineering as on that of electrical engineering.

There has been a grand group of Buckeyes coming from that commonwealth. I think some good historian will have to write the history of that group and tell the debt that the Westinghouse company and the engineering profession and the AIEE owe to such men as Stillwell and Lamme and Storer and Mershon and Skinner and Paul Lincoln and Scott and others.

When Mr. Storer came to the Westinghouse company in 1891 after his graduation, he says there was no student course, but they allowed him to go out into the shop and wind coils. So he wound coils for a short time and then he was asked by Mr. Lamme to run the original series of tests on the old number three railway motor. The number three railway motor to us Westinghouse men was the first single-reduction railway motor with a series winding upon the armature. And Mr. Storer, who says that this was one of the most interesting jobs that he ever had, was apparently so intrigued by applications of transportation in engineering that he stayed pretty well with it ever since.

Since Mr. Lamme gave the medal and Mr. Storer is receiving it, I thought it would interest you to hear a little quotation directly from Mr. Lamme at this particular period. Mr. Lamme was speaking not of a railway motor, but of a four-pole, ring-type generator-armature winding, in the days when there were no slots on the armatures and the winding had to stay right on the cylindrical core and sometimes after short-circuit shifted as much as three or four inches. Mr. Lamme asked Mr. Storer to attempt this job of winding, of which he said:

"This was one of the first jobs that was assigned to Mr. N. W. Storer. Regular winders did not think the construction possible, so we had to put on this work some man who was not so sure that it could not be done."

Another very interesting thing I found that Mr. Lamme said about Mr. Storer occurred about two years later, in 1893, when Mr. Storer was helping Mr. Lamme with the early development of the induction motor. Mr. Lamme said, "At the conclusion of the test Mr. Storer burnt off the insulation of the rotor end windings and then soldered both ends of his secondary windings solidly together in order to make the equivalent of a cage which also gave very good results." This, therefore, was the first real squirrel-cage motor in our early tests. Those men of you who have always thought that Mr. Storer was direct current without any alternating current will be pleased to know that he was in on the early development of the induction motor.

Dividing Mr. Storer's career into periods, the first is that from 1891 to 1904, when he was Mr. Lamme's first assistant. During that time he developed a line of d-c motors and generators. It is interesting to note that he speaks very highly of the contribution of Miss Bertha Lamme as his assistant at that time. She was the sister of B. G. Lamme.

During that period there were two things that were outstanding that Mr. Storer did, I think. One of them was the root-mean-square system of rating railway motors. At that time the pioneers had very little to go on. I was looking the other day at a photograph of a double-reduction railway motor with a huge cast-iron yoke around it. It looked nothing at all like our present motors, and the nominal or one-hour rating did not mean a thing, because the motors would not even run an hour idle at full voltage. That's quite true on account of the iron loss; it sounds funny but it was true anyway. But Mr. Storer, who perhaps knew about the root mean square—that is, figuring out for the different periods of the cycle that the motor operated what current was required, squaring them and multiplying by the time and dividing by the total time and extracting the square root—got the so-called root-mean-square current or rating. But he also realized that the iron loss must be made consistent with that, so he adopted the system of operating the motor on test at 300 to 400 volts. At that nominal rating at that voltage it did have a continuous rating. The combination of the iron loss and the copper loss very closely simulated the actual performance and that system has been universally used ever since.

The second achievement is his contribution to the thinking about the inertia of the rotating parts of the truck and of the motor itself to the tractive effort required to accelerate the entire combination.

Mr. Storer himself said about that, "Up to that time no consideration had been given to the energy that had to be stored in the wheels, gears, axles, and especially the armatures in accelerating them. I found that in the cars of that date the energy due to rotation of these parts was about ten per cent of the energy stored in the dead weight, making a total requirement of 100 pounds per ton to accelerate a car at one mile per hour per second, instead of $91^{3}/_{10}$ pounds."

Doctor C. F. Scott says that the first Institute paper that Mr. Storer delivered in 1902 was on that particular subject.

The next period of Mr. Storer's work is that from 1904 to 1912, when he was division engineer of the railway engineering department, entrusted with the sole responsibility for the development and the design and the operation not only of motors, but of control-line equipment and locomotives over the entire period. Those of us who lived through that time can remember what happened there; it was something like this: Main-line electrification of steam railroads really got under way. There were developed a-c d-c passenger locomotives, geared and gearless. The New York, New Haven, and Hartford electrification, in itself one of the mile posts in transportation development, occurred in this period. The third-rail d-c locomotive for the Pennsylvania Terminal, a-c freight locomotives of several types, and the New Haven switcher locomotives, a-c locomotives for St. Claire Tunnel and the Hoosac Tunnel were all developed. Commutating poles were first put in railway motors introducing speed control and used in the New Haven d-c zone, in the Pennsylvania Terminal locomotives, and in light tracks generally; and also 1,500-volt locomotives for the Piedmont and Northern Railway. All these were crowded into eight years and the responsibility for them rests on the man we are talking about today.

I might say that when they electrified the New Haven, they undertook one of the toughest problems that possibly ever could arise, because both the New York Central locomotives which operated on 600 volts direct current and the New Haven locomotives which operated on 11,000 volts alternating current had to run off the same trolley going into the Grand Central Terminal. That again illustrates the versatility of the man we are talking about.

In this period the particular achievement of Mr. Storer's that I want to speak about is the development of the quill-drive twin motor. Even on high-speed passenger locomotives, the direct-connected motor—that is, the one operating on the axle—was very slow speed. Mr. Storer says that in developing a higher-speed motor of practically double the speed he found that it had only about 50 per cent more horsepower on account of the increased width of the pinion, so that he conceived the idea of making twin motors operating through a quill—a drive which is practically universal in the world today for high-speed passenger service. It gets at once the higher speed, the smaller armature with less inertia, the double-voltage and half-current effect; and even the pinion face itself being less gives room for wider cores, so that the whole thing was a gain all the way through.

1864 BENJAMIN GARVER LAMME 1924
THE ENGINEER VIEWS HOPEFULLY THE HITHERTO UNATTAINABLE

AIEE Lamme Medal

The next period was from 1912 to 1926, when Mr. Storer was general engineer specializing on railway problems. In this period came up single-phase motor-generator-type locomotives, such as were used on the Detroit, Toledo, and Ironton when Mr. Ford went into the railway business; also the Great Northern electrification, where the frames of the motors were an integral part of the locomotive frames. Also high-voltage direct current came up for consideration quite prominently at that time. Those of us graceless youngsters who operated at that time about ten years behind Mr. Lamme and Mr. Storer got a lot of fun out of egging them on to debate the relative merits of single-phase alternating current and high-voltage direct current for traction purposes. You may have heard so much of that joke that perhaps you think there was a rift in the Westinghouse policy at that time, but there was not. Either man would have used the system that was best for the job he had in mind, but we used to get them to arguing.

During this high-voltage discussion we made mention of 1,500 volts for Piedmont, and then very soon of 3,000 volts for the Chicago, Milwaukee, and St. Paul. There again Mr. Storer's mechanical engineering as well as his electrical came into play, because he and Mr. Eaton, working together, produced locomotives which for mechanical balance were very beautiful and did the job that they had to do.

Also there came up another very interesting thing. Some of you may not have known that there was once a 5,000-volt d-c commercial application in this country. It was at Grass Lake, just outside of Jackson, Mich. It ran for two years and Mr. Storer designed the motors and the control. It was interesting from another point of view, because it involved a mercury rectifier, a rectifier not in the locomotive but in the substation.

(I like to think that in giving the medal Mr. Lamme wanted to perpetuate the kind of engineering that he knew best and did best, and that nothing would have given him more pleasure than to have seen it bestowed on Mr. Storer, who is a man after his own heart.)

The last period, from 1926 to 1936, Mr. Storer was consulting engineer and I think particularly of two projects that he worked on, one of which was connected with Diesel-electric propulsion, showing that he was coming right along up to date. The other was a byway, a very interesting system which you may have heard him describe. It consisted of three platforms side by side, one stationary and one running about 22 miles an hour and an intermediate one which periodically slowed down to a standstill and then speeded up to the speed of the third one. Thus you can move an enormous number of people who just step from the stationary platform onto the intermediate and finally onto the high-speed platform. Now that is interesting because it connects Mr. Storer with the New York World's Fair in 1939–40. The induction motors he was working on in 1893 were exhibited at the Chicago World's Fair in that year, and his byway very closely approximates the "futurama" of General Motors. This man whose engineering career lasted 45 years touched two World's Fairs that were 46 years apart, and touched them very actively.

So much for Mr. Storer's career. But what about Storer the man? When I first saw him in 1904, I thought that in personal appearance Mr. Storer was the most distinguished member of the clan Westinghouse and I never have had any occasion to change my opinion.

He is a man of considerable physical strength. He likes games that involve muscular effort. My memory slows me down again by reminding me that when the Pennsylvania Terminal was electrified Mr. Storer and Mr. Eaton were down there working on the job and they had an idle moment and on one of the six-foot platforms they indulged in a little knee-and-elbow wrestling; that kind of wrestling in which you take the other man's hand and put your foot and your knee against his and then see which can upset the other. And thereby the Westinghouse company nearly lost a perfectly good chief mechanical engineer, because Mr. Eaton departed hastily and landed on the tracks down below.

Mr. Storer is just as good as he looks in many other ways. He is as good as he looks in moral character, in sense of humor, and in rugged honesty that believes in fighting for what is worth fighting for. In his civic and social interests he has been very broad. He is a man of real culture, the best kind of culture. I wish those who haven't noticed or haven't carefully read Doctor Parker's article on "This Culture" in the June issue of ELECTRICAL ENGINEERING would get and read it, because it is very elegantly expressed as English goes, and it sets forth the dictum that beautiful engineering material handled by great teachers can give us as much culture as we could possibly get in any other way. He mentions, not by name, some of the great teachers that he and I both had at the University of Michigan. I really think, without trying to hand this culture business back to the educators, that it is possible to get real culture out of engineering.

I should like to pay my own personal tribute to Mr. Storer, who inspired me and steadied me as a young man. He was about ten years older than I was, and ten years wiser in professional experience; a man who is hero-worshipped. Tentatively I at first started to call him "Uncle Norman." After a while I got a little bolder and called him "Norman"; he has been "Norman" to me ever since and he has done a lot of things for me. So I give you, for the Lamme Medal, that grand pioneer engineer, that matchless good citizen, that unavowed chieftain of the great Buckeye nation, Norman Wilson Storer.

Medalist Storer's Response

I appreciate deeply the honor that has been conferred upon me. It is all the more pleasing to me because of my close association with Mr. Lamme many years ago.

It was from 1891 up to 1924 that I was very close to Mr. Lamme. We didn't fight over alternating current or direct current. Lamme wouldn't discuss it with me. I think he was a little afraid. But he said, "Well, we've got to make this a-c stuff; we got started on it." I gave him 5,000 volts direct current, but that was too high. They didn't need such high voltage. But I can assure you that with either alternating or direct current on the trolley you can do any piece of railway electrification work which is to be found in the country, and then some.

But after all the pioneer work and all we have passed through it is disappointing to the engineers to find that so little has been accomplished in the percentage of railways electrified in this country. It is far too small, and especially at a time like this.

A year ago, a little over, I listened to a very interesting lecture by Colonel W. J. Wilgus, delivered at a little University Club powwow down in Winter Park, Fla. Colonel Wilgus called the railways our first line of defense and in order to make it safe for the country he proposed that the government should own all of the railroads and operate them under one head.

I am not going to go any further than that. That statement was well backed up by Colonel Wilgus. But right now, I think we have got to mind our p's and q's; get our railways system in good operation, as well as battleships. Colonel Wilgus said in effect, "If you don't have the transportation—railway transportation, you might just as well take the battleships out and sink them."

There is one thing that I wanted to say about this medal. I feel embarrassed in receiving as much credit as Doctor Dudley has handed out. I think that it ought to be recognized that I am only one out of many who have been mixed up in all these propositions and a great deal of credit goes to those who worked with me on the job. I had some of the most loyal and best men working with me on all those jobs that I ever came across, and I want to give them full credit.

Of Current Interest

Industry • • • •

EEI Adopts Preparedness Resolution

During its eighth annual convention, the Edison Electric Institute at Atlantic City on June 5, 1940, unanimously adopted the following resolution as representing the attitude of the electric-utility industry of the United States:

Whereas, Our Government is taking steps to assure the speedy strengthening of our national defense, and

Whereas, this will require the expenditure of billions of dollars of public funds which must be reflected in added public debt and increased taxes, and

Whereas, it should be the function of private capital to provide, so far as practicable, for the financing of industrial needs and expansion of facilities in this emergency to the end that government funds may be released for those things which only government can do, and

Whereas, the electric light and power industry, built up in this country through the past sixty years by private capital and individual initiative and now supplying 90 per cent of the electric public-utility service of this country, is able and anxious to do its full part in this hour of national emergency, and

Whereas, for the manufacture of munitions of war the electric utilities of this country have a great responsibility in the supplying of adequate electric power to those industrial establishments which depend upon central-station service, and

Whereas, the electric utilities are presently prepared with and will maintain ample plant facilities and the trained, experienced, and efficient organizations required to discharge this great responsibility;

Be It Resolved that the members of the Edison Electric Institute, in convention assembled, express their willingness and readiness to devote their full capabilities, their best efforts, and their resources to aid our country by continuing to maintain an ample supply of electric power for war industries.

In his presidential address to EEI conventioneers, EEI President C. W. Kellogg reminded his listeners of the following pertinent facts:

"Since a large part of American industry is electrified, an adequate power supply to turn the wheels of industry is a basic necessity of the country. Although many industrial establishments have their own power sources, still the electric utilities supply about three-quarters of all the electric power used by industry in this country and therefore face a great responsibility in the present situation. They can face it, however, with complete confidence, for they are prepared with the requisite plant facilities, experienced organization and personnel, and existing sound business relationships, to meet the responsibility. Never in history has any country been so well equipped with power for the production of munitions as is our country today. Let us consider some of the more important factors which verify our state of preparedness.

"At the end of 1939 installed generating capacity in the United States exceeded the sum of the noncoincident peak demands on our power stations by over 40 per cent. In the industrial areas of the nation, where the munitions of war would be produced, this margin was 39 per cent. Effectively this margin is even greater, due to the network of interconnection between power plants and power systems, the diversity of whose requirements makes the combined instantaneous peak demand substantially less than the sum of the noncoincident peak demands.

"The utility industry will add 1,640,000 kilowatts of generating capacity in 1940 and a further million and a quarter kilowatts of generating capacity is already planned for completion in 1941; still more can be provided if conditions require to keep ahead of the normal rate of growth and maintain the margin. A large part of this new capacity is to be in steam plants, located in the industrial areas. In addition, in 1940 the Federal Government will add 230,000 kilowatts of generating capacity in the TVA and other areas.

"Ample power capacity is available to supply all the existing industrial establishments of the United States. Incremental new power capacity can be added just as fast as new munitions factories could be built.

"The power industry now has three and a third times as much generating capacity, and an annual output of electric energy four times as great, as in 1917, when we entered the World War. True, we have taken on much greater responsibilities in supplying power to industry since that time, but the amount of generating capacity in isolated industrial power plants has remained about the same from 1917 to date. In the meantime, while we have gained in capacity 230 per cent and in output 300 per cent, the corresponding gain in population has been only 29 per cent; and the gain in industrial production, as measured by the output of all kinds of factories, is about 15 per cent."

Experiments With Radiotelephony for Freight Trains Authorized

The Central Railway Signal Company of Proviso, Ill., has been authorized by the Federal Communications Commission to experiment in radiotelephone communication between the central control tower of a railroad freight yard and locomotives therein. The FCC issued to the company construction permits for two Class II experimental stations at Proviso, each to operate with 15 watts power.

Such communication will be limited to the railroad classification yard. The messages to be transmitted will consist of orders relative to the classifying and sorting process in moving freight. The authorizations are for experimental purposes only. If the demonstration is successful, applications for operation on a permanent basis will be received from railroads interested in such service.

Though the Commission has granted experimental authorizations to certain railroads for the purpose of investigating the practicability of train radio communication, no permanent assignments of frequencies have been asked. An engineering conference was held by the Commission in 1936 for the purpose of allowing all interested parties to state their future radio needs. The evidence presented at this hearing was used as a basis for allocating frequencies of from 30,000 to 300,000 kilocycles. The railroad companies failed to appear or to make showing at that time as to the need for frequency assignments within that range for railroad use.

Ralph Modjeski, long-time recognized leader of the bridge-engineering profession in America died at the age of 79 in Los Angeles, Calif., June 26, following a long illness. Born in Poland and educated in Paris, he collaborated in 1885 on the construction of the Union Pacific Railroad bridge over the Missouri River at Omaha, Nebr. By 1893 he had opened consulting offices in Chicago. His famous structures include the Quebec cantilever bridge, the Philadelphia-Camden suspension bridge, and the San Francisco-Oakland Bay bridge, although his early fame was built on the construction of a series of notable simple-span railroad bridges across the Mississippi, including the Thebes and Memphis structures.

Raymond F. Walter, chief engineer of the United States Bureau of Reclamation since 1925, died in Fresno, Calif., June 30. Affiliated with the Reclamation service since 1903, he is credited with the direction of the planning and construction of all the great works for which recent Reclamation construction is notable, including Owyhee and Boulder Dams, the All-American Canal, the Grand Coulee project on the Columbia River, and the current Central Valley projects on the Sacramento River in California.

Sidney O. Harper has been appointed chief engineer of the United States Bureau of Reclamation, with headquarters at Denver, Colo. Since his graduation from the University of Colorado in 1907, he has spent his entire professional life with the Bureau. He became general superintendent of all reclamation construction in 1925, and his title was changed in 1930 to assistant chief engineer.

Navigation Light on Memorial. A navigation light, said to be the largest on the Great Lakes, and consisting of two 300-millimeter electric lanterns, each equipped with a 500-watt lamp and doublet lenses, recently has been installed on top of the 352-foot Perry's Victory and International Peace Memorial monument at Put-In Bay, Ohio. The light will operate about nine months of the year, and is also expected to aid aviation.

Time Factor in Defense Production. Declaring that the most misunderstood aspect of American industry is the time factor of preparation for mass production, C. F. Kettering (A'04, F'14) vice-president in charge of research, General Motors Corporation, recently pointed out that reports of producing 1,000 airplanes a day for the United States defense program may lead to disappointment unless the people can be given a clearer understanding of how long it takes to get ready for mass production of machines. It takes more than a year to put out a new model automobile, he said, suggesting that more complex machines require still more time for preparation. Military authorities must decide what type of defense equipment is needed; then American industry stands ready to produce it in quantity, Doctor Kettering declared. He warned that indecision or minor changes in specifications can effectively nullify a mass-production program.

Coffin Award to Washington Water Power Company. "For distinguished contribution to the development of electric power for the convenience of the public and the benefit of the industry," the Washington Water Power Company, Spokane, has been awarded the 1939 Charles A. Coffin gold medal, and related purse of $1,000 for the company's employment benefit fund. The award, which was established in 1922 by the General Electric Company as a tribute to the memory of its late founder Charles A. Coffin, was presented during the recent (June 3–6) annual convention of the Edison Electric Institute at Atlantic City, N. J.

Education

Test Car to Purdue Museum. The "Louisiana," historic interurban test car used in making air-resistance measurements at the Louisiana Purchase Exposition, St. Louis, Mo., in 1904, has been placed in the Railway Museum of Purdue University, Lafayette, Ind. At the close of the Exposition, the car was placed at Purdue by the Electric Railway Test Commission, and the University co-operated with the Commission in making further tests. Since 1910 the car has been part of the laboratory equipment for classes in electrical engineering, but removal of tracks by the local traction company caused its retirement to the museum.

Iowa State Awards Medal. The Marston Medal, highest honor of the engineering division of Iowa State College, Ames, was awarded this year to James W. Hook, president and director of the Geometric Tool Company and of the United Illuminating Company, New Haven, Conn., who was graduated in mechanical engineering from Iowa State in 1905.

George Westinghouse Scholarships Awarded. Ten high-school graduates have been selected to receive $3,000 George Westinghouse Scholarships for study at Carnegie Institute of Technology. The scholarship-holders will combine a formal engineering course with practical experience at Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. Ten similar scholarships were awarded in 1938 and in 1939. The 1940 winners are:

Aubrey Brister, Dallas, Tex.; W. Carpenter, Chattanooga, Tenn.; J. H. Dickson, Jr., Edgewood, Pa.; K. J. Ferrell, Washington, Pa.; L. S. Frost, Wilkinsburg, Pa.; W. D. Lyon, Fullerton, Calif.; Harold Schweinler, Jr., Tacoma, Wash.; E. L. Tennyson, West Orange, N. J.; J. A. Voelz, Shorewood, Wis.; J. L. Wolff, Greensburg, Pa.

Other Societies

ASTM Announces Officers, Medalists

Officers for the American Society for Testing Materials for 1940–41, announced at the annual meeting of the society, Atlantic City, N. J., June 24–28, are as follows:

President: W. M. Barr, chief chemical and metallurgical engineer, Union Pacific Railroad Company, Omaha, Nebr.

Vice-President: H. J. Ball, head of the department of textile engineering, Lowell Textile Institute, Lowell, Mass.

Members of executive committee: R. C. Griffin, treasurer, Arthur D. Little, Inc., Cambridge, Mass.; P. D. Merica, vice-president and director, International Nickel Company, Inc., New York, N. Y.; Jerome Strauss, vice-president, Vanadium Corporation of America, New York, N. Y.; Stanton Walker, director, engineering and research division, National Sand and Gravel Association, Washington, D. C.; C. H. Fellows, head of chemical division, research department, Detroit Edison Company, Detroit, Mich.

The Charles B. Dudley Medal, for the paper of outstanding merit, constituting an original contribution to research, presented at the previous annual meeting of the society, was awarded to T. F. Willis and M. E. DeReus, Missouri State Highway Department, for their paper "Thermal Volume Changes and Elasticity of Aggregates and Their Effect on Concrete." The authors also received the first Sanford E. Thompson award, established by the society's committee on concrete and concrete aggregates for the outstanding paper in that field.

Future Meetings of Other Societies

American Chemical Society. Fall meeting, September 9–13, 1940, Detroit, Mich.

American Gas Association. October 7–10, 1940, Atlantic City, N. J.

American Institute of Mining and Metallurgical Engineers. Regional meeting, September 10–13, Salt Lake City, Utah.

Joint meeting, AIME Coal Division, ASME Fuels Division, November 7–9, 1940, Birmingham, Ala.

American Institute of Physics. Conference on applied nuclear physics, with Massachusetts Institute of Technology, October 28–November 2, 1940, Cambridge, Mass.

American Physical Society. 237th meeting, November 22–23, 1940, Chicago, Ill.

American Society of Civil Engineers. Fall meeting, October 16–18, 1940, Cincinnati, Ohio.

American Society of Mechanical Engineers. Fall meeting, September 3–6, 1940, Spokane, Wash.

American Transit Association. 59th annual convention, September 23–26, 1940, White Sulphur Springs, W. Va.

American Welding Society. Annual meeting, October 20–25, 1940, Cleveland, Ohio.

Association of Iron and Steel Engineers. Annual convention, September 24–27, 1940, Chicago, Ill.

Conference on Electrical Insulation (National Research Council). October 31–November 2, 1940, Washington, D. C.

Engineers' Council for Professional Development. Annual meeting, October 24, 1940, Pittsburgh, Pa.

Illuminating Engineering Society. 34th annual convention, September 9–12, 1940, Spring Lake, N. J.

National Electrical Manufacturers Association. Annual meeting, October 27–November 1, 1940, New York, N. Y.

National Metal Congress. October 20–25, 1940, Cleveland, Ohio.

National Safety Council. October 7–11, 1940, Chicago, Ill.

From AEC

ITEMS appearing under this heading are from the news service of American Engineering Council.

Defense Program Begins to Take Form

Preparedness for war continues to occupy the center of the Washington stage, as the newly appointed National Defense Commission, still in the throes of organization, begins its tremendous task. As of July 1, appropriations already approved totaled $5,362,319,748, with additional amounts still to be acted upon by Congress.

The authorized strength of the Army has been increased from 227,000 enlisted men to 375,000 with clear indications that this number will soon be increased further, and Army officials protesting that 500,000 is the maximum number that can be trained in the immediate future because of limitations in officers and equipment. Nevertheless, a supplementary proposal will soon be submitted to Congress calling for the ultimate expenditure of between five and seven billion dollars, including large amounts for the procurement of tanks, anti-tank and anti-aircraft guns, other artillery, and motor vehicles, as well as perhaps $1,000,000,000 for government-owned plants to produce ordnance, chemicals, explosives, and other needed supplies.

One minor item in the program already approved is the voting of $18,500,000 for construction work in expanding 25 existing Army posts to provide training facilities for the expanded personnel.

As regards the Navy, Congress on June 27 voted funds for the construction of 68 new vessels and the modernization of 71 others now obsolete. Contracts covering some of the new construction were awarded within a few days, over $150,000,000 worth being assigned to five navy yards and an additional $500,000,000 to private shipyards. The former include 10 destroyers and 9 submarines; the latter 11 cruisers, 20 destroyers, 13 submarines, and 1 large seaplane tender. Additional awards will follow shortly. These contracts are in addition to those let earlier covering 23 vessels costing $350,000,000.

These figures are dwarfed, however, by a proposal already passed by the House providing for a two-ocean Navy increased 70 per cent in size over that now existing, and involving a seven-year program to bring Naval strength to 750 vessels. If adopted, this program, in conjunction with construction already approved, will mean the expenditure of $1,000,000,000 per year for seven years.

To meet these demands the United States has, according to testimony by Rear-Admiral S. M. Robinson, chief of the Bureau of Engineering, a total of 137 privately owned shipways now in commission, plus 78 now out of service and 18 more in government-owned navy yards.

SUPERVISION OF PROGRAM

To co-ordinate this tremendous effort the National Defense Commission is rapidly perfecting its organization, and the federal departments concerned are steadily increasing personnel. The Commission has named a large number of advisory committees representing various sectors of industry, and has placed Donald M. Nelson, head of the Treasury's procurement division, in charge of co-ordinating all purchases. Mr. Nelson, formerly with Sears, Roebuck & Company, will shortly recommend steps to simplify the government's cumbersome purchasing system and to procure priority for defense orders over private purchases when necessary. He will not take over the burden of direct purchases by the Army and Navy, but will co-ordinate them with those of other federal departments.

President Roosevelt has filled two of the three vacant executive White House posts granted by the Reorganization Act. These appointees will probably work closely with the defense commission. They are James V. Forrestal, president of Dillon, Read and Company, New York investment house, and Daniel J. Tobin, president of the Brotherhood of Teamsters and a vice-president of the American Federation of Labor.

Also tied in with the defense program are the appointments of Henry L. Stimson as Secretary of War and Frank Knox as Secretary of the Navy. The objective of these two appointments is to place the defense program on a nonpartisan basis.

METHOD OF FINANCING

To defray part of the cost of the huge armament program Congress has enacted a new tax bill designed to yield an additional $1,000,000,000 annually in Federal revenues through increases in the income tax and in numerous other taxes, and has also increased the Federal debt limit from $45,000,000,000 to $49,000,000,000. President Roosevelt has also recommended the enactment of excess profit taxes, a suggestion now being considered by Congress.

To finance the large amount of plant expansion necessary to fulfill orders for armament the defense committee has already been voted $200,000,000, and the Reconstruction Finance Corporation has been given authority to make loans for the expansion of plant facilities and for the acquisition of materials needed for defense. As already stated, plans are rumored for the later request for an additional $1,000,000,000 for new plant construction under government auspices. War Department plans for the contingency of a major war estimate the need for 120 plants for the manufacture of special types of equipment and material, such as explosives and chemicals, that cannot readily be manufactured in existing factories.

LABOR PROBLEMS

Employment in new fields for thousands of men and women naturally gives rise to many problems of adjustment that are being given careful consideration. Sidney Hillman, a member of the National Defense Committee, is in charge of this particular activity, and has already announced a plan to train 50,000 persons during the summer for industrial jobs connected with defense. State and industrial vocational training directors have met in Washington to discuss plans for this effort, which is expected to utilize all available facilities for apprentice training. Engineering schools will be called upon to give short courses in drafting, surveying, and other applicable techniques. The training will be financed by allotments from funds of the WPA and the Office of Education, supplemented by additional appropriations.

Looking beyond the immediate need, President Roosevelt has under study a plan for the annual training of 2,000,000 youths each year for national service in the armed forces, the service of supply, and the industries which support them. Details are unsettled.

The United States Employment Service is planning to expand its present set-up in order to take over the task of filling demands for both skilled and unskilled labor, if necessary by transfer from one region of the country to another. It requests all employers having present or potential need for such employees to inform it promptly of the extent and nature of these requirements.

Complicating the labor problem is the concurrent need of building up the enlisted strength of the Army and Navy. The Army plans this summer to call 9,000 reserve officers for special training, while the Navy has announced a plan to train 5,000 new ensigns by means of a special short course involving 90 days of shore training plus 30 days at sea.

OTHER FEATURES

Among other activities of particular interest to engineers, are the following:

The Treasury has been voted $47,500,000 for the acquisition of strategic materials and minerals in which shortages are apt to develop. The Reconstruction Finance Corporation, as already noted, has also been authorized to make loans for a similar purpose, and has announced its intention of immediately purchasing 150,000 tons of rubber and 75,000 tons of tin to be held in reserve.

A third set of locks for the Panama Canal has been voted, with an appropriation of $15,000,000 plus $99,000,000 in contract authorizations.

President Roosevelt has asked for the appropriation of $25,000,000 for the installation of additional generating facilities in the Tennessee Valley Authority system.

The Commissioner of Patents has been authorized to withhold the granting, and hence the publication, of patents on devices relating to national defense.

The Census Bureau will give priority to the production statistics useful in defense in analyzing returns from the 1940 census.

Plans for the utilization of existing methods of communication for military purposes in case of war, and for the suppression of "fifth column" activities by radio amateurs, are being prepared by the Federal Communications Commission.

A National Defense Research Committee, headed by Dr. Vannevar Bush (A'15, F'24) president of the Carnegie Institution, has been organized "to accelerate the creation or improvement of instrumentalities for national defense." One of its problems will be the question of publishing the results of scientific investigations that might react to the advantage of a potential enemy.

D. C. Jackson Heads Committee on Engineering Ethics

A committee has been appointed by President Alonzo J. Hammond of AEC to prepare a code of ethics for the engineering profession, which can be adopted by AEC member organizations with whatever modifications their specific needs require. Chairman of the committee is Dugald C. Jackson (A'87, F'12) professor emeritus, Massachusetts Institute of Technology, who represents the AIEE and the American Institute of Consulting Engineers. Other members are W. H. Kenerson, chairman, division of engineering, Brown University, representing the American Society of Mechanical Engineers; A. W. Dean, retired chief engineer, Massachusetts State Planning Board, American Society of Civil Engineers; J. W. Barker (M'26, F'30) dean of engineering, Columbia University, Society for the Promotion of Engineering Education. The American Institute of Mining and Metallurgical Engineers is being represented by Doctor Scott Turner as an observer.

In 1912 the AIEE board of directors formally adopted a "code of principles of professional conduct" for its members. Doctor Jackson served on the advisory committee that formulated the code, and since 1938 has been chairman of the Institute's standing committee on code of principles of professional conduct.

Board to Co-ordinate Public Works Plans

President Roosevelt has directed Federal agencies engaged in construction activities to submit their plans for the future to the National Resources Planning Board, which will assemble them into a continuing plan looking six years into the future in order to indicate desirable priorities and avert conflicts among agencies engaged in different types of work.

The Board will maintain a review staff to work in collaboration with the director of the budget in the preparation of Federal programs affecting land (including reclamation, land purchases, forests, and parks); water (including flood control, power development, pollution); transportation (public roads, navigation improvements), and other undertakings involving Federal construction activities. It is expected to submit statements of plans and policies for transmission to Congress each year in connection with the annual budget that will permit the adjustment of Federal work to help stabilize trends in employment and business activity. To fulfill this duty it will also be necessary for the Board to assemble reports by its own staff and other Federal agencies reflecting such trends in economic conditions.

Rates Based on Net Cost Set for Hydroelectric Plant

Acting on its first rate case involving a licensed hydroelectric development, the Federal Power Commission has ordered the Safe Harbor Water Power Corporation of Pennsylvania, to reduce its wholesale power rates so as to provide a net return of not more than 6 per cent on the net investment in its properties, plus adequate working capital, thus upsetting the traditional "fair value" rate base that gives weight, among other things, to estimated reproduction cost. The decision was supported by four of the five commissioners, with the dissenter differing, not in principle, but in the belief that a return of only $5^1/_2$ per cent should be permitted on the net investment.

In announcing its decision the Commission points out that the old rate-making principle has been time-consuming, burdensome, and subject to economic shocks. The net investment base, on the other hand, is founded upon established facts "and is not subject to the vagaries of theories, imagination, and abrupt fluctuations of prices and conditions."

The Safe Harbor Company is a wholly owned subsidiary of the Consolidated Gas, Electric Light and Power Company of Baltimore, Md., and the Pennsylvania Water and Power Company, which purchase its entire output.

Tighter Federal Fiscal Control Urged

In a report published July 1, the Brookings Institution, an independent research group, makes a number of recommendations designed to increase the responsibility of Congress for Federal expenditures. Perhaps the most important of these is a proposal that the two houses create a joint committee on appropriations with a permanent staff of experts competent to advise on budgetary and financial matters, thus eliminating the present method of compromise adjustments of appropriations between actions taken by the House and the Senate, each advised by a separate committee on appropriations. The recommended procedure is already followed in matters of taxation.

Other recommendations include the reconstruction of the government's accounting and reporting system, and the elimination of political appointees from the Bureau of Internal Revenue and the Customs Bureau.

New Air Routes Opened

Overseas air-transport service under American ownership and operation is being greatly expanded by Pan-American Airways' inauguration of new routes to Alaska and New Zealand, and increased service to South America.

Service to Alaska started June 24 with a flight from Seattle to Ketchikan, which continued next day to Juneau, where connections are made with existing airways serving many parts of the territory. Two round trips per week are scheduled.

Air-mail service was scheduled to open July 12 to New Zealand from San Francisco and Los Angeles in $4^1/_2$ days, with stops at Honolulu, Canton Island, and Noumea. Passengers will not be carried at present.

Service to South America has been augmented by daily trips from Miami to Buenos Aires, alternating between the east- and west-coast routes, in addition to four new schedules in the Caribbean area and a fifth through Central America and across the northern part of South America. Four-engined Boeing "strato-clippers" will operate twice weekly at high altitudes between Miami and Barranquilla, Colombia, where connections will be made for points further south.

New development in continental air service is the strato-liner service from New York, N. Y., to the Pacific Coast, which started July 8, 1940.

Letters to the Editor • • •

INSTITUTE members and subscribers are invited to contribute to these columns expressions of opinion dealing with published articles, technical papers, or other subjects of general professional interest. While endeavoring to publish as many letters as possible, Electrical Engineering reserves the right to publish them in whole or in part or to reject them entirely. Statements in letters are expressly understood to be made by the writers; publication here in no wise constitutes endorsement or recognition by the AIEE. All letters submitted for publication should be typewritten, double-spaced, not carbon copies. Any illustrations should be submitted in duplicate, one copy an inked drawing without lettering, the other lettered. Captions should be supplied for all illustrations.

Matrices and Dyadics

To the Editor:

It is very gratifying to note that in spite of the wars there are still persons interested in matrices and dyadics as shown by papers by Reed[2] and by Pipes.[1,3] After reading these more recent contributions on the subject, the writer is still of the opinion that in the application of matrices and dyadics to the analysis of *three-phase circuits*, dyadics have many valuable properties not shared by matrices.

Take Reed's paper.[2] He has used the following matrices:

$$\mathfrak{U}_1 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}, \mathfrak{U}_2 = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \end{bmatrix},$$

$$\mathfrak{U}_3 = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}, \text{ and } \begin{bmatrix} 2 & -1 & -1 \\ -1 & 2 & -1 \\ -1 & -1 & 2 \end{bmatrix}$$

in addition to relations for the transformation of line-to-line quantities to line-to-neutral quantities and vice versa. It will be noted that $\mathfrak{U}_1$, $\mathfrak{U}_2$, $\mathfrak{U}_3$ are exactly the writer's[4] $\mathfrak{I}$, $\mathfrak{K}$, $\mathfrak{J}$, the properties of which have been discussed at some length. As for the last matrix, it is nothing more than three times the dyadic $(\mathfrak{I}-\mathbf{uu})$, known as the "zero-sequence eliminator". In this dyadic **u** is the versatile isoclinic unit vector, that is, a vector equally inclined to the three rectangular co-ordinate axes, which plays a rôle in star-delta transformations much like that played by the imaginary unit $j=\sqrt{-1}$ in single-phase discussions of balanced three-phase circuits. Just look at the transformation formulas (reference 4, page 46).

$$\mathbf{E}_{bc} \text{ (line-to-line) } = \sqrt{3}\mathbf{u}\times\mathbf{E}_a \text{ (line-to-neutral)},$$

$$\mathbf{I}_a \text{ (star value)} = -\sqrt{3}\mathbf{u}\times\mathbf{I}_{bc} \text{ (delta value)}$$

and compare them with:

$$\mathbf{E}_{bc}=\sqrt{3}j\mathbf{E}_a \text{ and } \mathbf{I}_a=-\sqrt{3}j\mathbf{I}_{bc}$$

The writer heartily endorses Reed's statements, made in discussing Pipes' recent paper[3]:

> ". . . insofar as static networks are concerned, the tensor concept and, therefore, transformation from an old to a new space is not necessary. In fact, the *C* matrix of Kron and the *A* matrix of Pipes are somewhat artificial when applied to static network theory. These transformations are used to establish the impedance matrix for the physical network. But this may be done rather easily by means of Kirchhoff's voltage equations in terms of Maxwell's cyclic currents . . . ."

The dyadician's viewpoint in the analysis of such circuits is best illustrated by using the wye-wye circuit of Pipes. After several transformations, during the course of which a good number of zeros were introduced in order to construct high-order matrices out of low-order ones, Pipes[3] eventually calls attention to his equation 45. This equation holds the key to the solution of the present problem and can be set up without any ado by the dyadician from the single-line diagram of the wye-wye connection thus:

$$\mathbf{E}_s=\mathbf{E}_r+(\mathfrak{Z}_s+\mathfrak{Z}_L+\mathfrak{Z}_r)\cdot\mathbf{I}_n$$

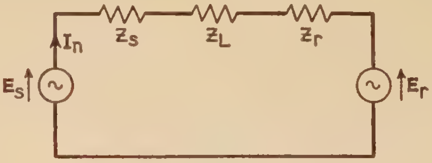


Figure 1

As for the delta-delta and delta-star networks, the reader interested in the viewpoint of the dyadician will find a good many solved examples in chapter 5 of reference 4.

Aside from the remark of Reed concerning static networks already quoted, the writer would like to go one step farther and state that even in *three-phase machines* (whether operated normally or non-three-phase), the useful and usable reference axes are limited in number (reference 4, chapters 7 and 8). These are:

1. The phase axes, **i**, **j**, **k**;
2. The stationary complex axes of symmetrical components, **u**, **f**, **b**;
3. The rotating axes, **u**, **s**, **n**; and
4. The axes of two-reaction theory, **u**, **d**, **q**.

The transformation from any one system of the above to any other is not so difficult as to require a *general* transformation theory for its understanding. It seems that the utility of the general transformation is not at all realized in the considerations involving *three-phase circuits*, whether static or rotating.

Be he a dyadician or a matrician or a tensorist, his avowed object is generalization. It is the opinion of the writer that in engineering applications, generalizations should be along directions which will make the new relations more readily understood from simple analogy with the old and well-established ones. Thus the generalization of Ohm's law from $E = RI$ for a d-c circuit to $\mathbf{E} = \mathbf{ZI}$ for an a-c circuit and to $\mathbf{E} = \mathfrak{Z}\cdot\mathbf{I}$ for a three-phase circuit deserves high commendation. It is in conformity with this basic principle when a dyadician analyzes a three-phase network after the pattern used in the study of single-phase circuits. The combination of partitionable dyadics, or square matrices having nine elements, into rectangular or square arrays with lots of added zeros naturally is not in keeping with the purpose of the dyadician. To the writer and other children playing with mathematical tools, such a "building" program as that given by Pipes looks more like the work of a skillful magician (matricians, please pardon) whose trick is difficult to expose, than like that of a careful, perhaps conservative dietitian (dyadician) whose prescription is easy to follow.

While on the subject of generalization, an interesting example immediately seen by the dyadician but not yet brought to light by the matrician so far is that of general circuit constants A, B, C, D. These four scalars appear in the following equations relating to the sending- and the receiving-end quantities:

$$E_s = AE_r + BI_r$$
$$I_s = CE_r + DI_r$$

and they satisfy the constraining condition imposed by a bilateral network:

$$AD - BC = 1$$

In three-phase circuits, these four scalars can be generalized into dyadics and can be used in the same way as the scalars (reference 4, page 248). However, the constraining condition generalizes into

$$\mathfrak{A}\cdot\mathfrak{D}_t - \mathfrak{B}\cdot\mathfrak{C}_t = \mathfrak{I} = \mathfrak{D}\cdot\mathfrak{A}_t - \mathfrak{C}\cdot\mathfrak{B}_t$$

in which the subscript t is used to denote the transposed dyadic. It is quite apparent why a matrician missed this generalization, because his creed is to build from low-order matrices high-order arrays.

In concluding, an apology for constantly referring to the book "Dyadic Circuit Analysis" is certainly in order, lest the reader may think this an advertisement. The fact is that the writer's personal collection of papers on dyadics have all been lost in Peiping when Japanese soldiers took over the campus of National Tsing Hua University in 1937. Herein lies an irony of fate, for the first paper on dyadics was written in response to the call of the Japanese Government when they convened the World's Engineering Congress at Tokyo in 1929 and the final manuscript on the same subject barely escaped the ire and the fire of the army from the same government. Well, a cat often devours what she begets! Why complain?

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1. MATRICES IN ENGINEERING, **L. A. Pipes.** ELECTRICAL ENGINEERING (AIEE TRANSACTIONS) volume 56, September 1937, pages 1177–90.

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3. TRANSFORMATION THEORY OF GENERAL POLYPHASE NETWORKS, **L. A. Pipes.** AIEE TRANSACTIONS, volume 59, 1940 (February section), pages 123–8.

4. DYADIC CIRCUIT ANALYSIS (a book), **A. Pen-Tung Sah.** International Textbook Company, Scranton, Pa., 1939.

A. PEN-TUNG SAH (A'35, M'36)

(President, National University of Amoy, Changting, China)

Nonexistent Difficulties in Welding

To the Editor:

Arc welding has too many doctors. An operation which is perfectly natural, very simple, and very easily accomplished largely has been changed in the minds of the public to an art which takes on the mystery of voodooism with an admixture of the art of the medicine man.

The public is beginning to think that the welding operator is a cross between a miracle man and a professional magician. This opinion is groundless. The only thing that a welding operator can do is to hold the end of an electrode at a certain distance above the deposited metal and advance it at a certain speed along the seam to be welded. There is nothing more involved in the operation. It is neither complicated nor difficult. As a matter of fact, with proper electrode, proper setting of the welding machine, and proper preparation of the work, it is practically impossible to make a weld which will not stand up in service without having its defects so evident to the inspector that he would immediately reject it. It is possible to have defects in the steel that cannot be seen, which will make a steel structure dangerous. It is impossible, however, to make a weld on that structure which is dangerous without its being obvious to anyone looking at the weld.

The chief reason we hear so much about the necessity of skill and care in welding is that the operation itself is so simple that it is difficult to find much about it to discuss in papers, lectures, and statements. Therefore, many of the eccentricities which are volubly discussed consist of theoretical possibilities that usually exist only in the minds of the lecturers and seldom exist in reality.

It is time that we got away from trying to make this very simple operation mysterious. It is time we recognize the fact that the metal deposited by the shielded-arc electrode is definitely better than the parent metal it is joining. It is time we recognize that there has never been a failure on an insured pressure vessel made by the shielded-arc process. It is time we recognize that in the usual design if only half a weld is made it will withstand all of the normal requirements of the structure. It is time we recognize that failures never exist in welds which are made by the methods recommended by any reliable manufacturer. It is time we recognize that there is no mystery in welding, and that making a welded joint is far more simple than making a riveted joint and more simple than making the steel which is joined together by this process. It is time we recognize that to spend time, money, and attention in removing the least possible flaw from the deposited metal is silly in the light of the obvious flaws which must occur in the parent metal. A factor of safety is used to guard against these flaws. That is more than is needed in any commercial weld.

When we do recognize these facts we will have done two things: First, we will have given the green light to one of the most economical processes now known for the production of many structures; secondly, we will have removed one of the fears which the uninitiated have developed regarding a perfectly normal manufacturing operation.

J. F. LINCOLN (A'08, F'39)

(President, Lincoln Electric Company, Cleveland, Ohio)

Books Received •

The following new books are among those recently received at the Engineering Societies Library. Unless otherwise specified, books listed have been presented by the publishers. The Institute assumes no responsibility for statements made in the following summaries, information for which is taken from the prefaces of the books in question.

DESIGN OF ELECTRICAL APPARATUS. By J. H. Kuhlmann. Second edition. John Wiley and Sons, New York, 1940. 506 pages, illustrated, $9^1/_2$ by 6 inches, cloth, $5.00. Practical methods of design are given for the d-c machine, synchronous machine, induction motor, and transformer. Includes complete explanations of the construction, procedure, formulas and limits of design, and sample calculations for several pieces of electrical apparatus.

ECONOMICS OF TRANSPORTATION IN AMERICA. By K. T. Healy. Ronald Press Company, New York, 1940. 575 pages, maps, etc., $9^1/_2$ by 6 inches, cloth, $4.00. A study of economic forces and motives, and the reasons for economic phenomena in transportation. A historical introduction is followed by an analysis of demands for transportation and a résumé of the construction and development of transportation facilities. The functioning of these facilities and their regulation by government action are considered in detail. Brief bibliography and list of railroad histories.

PLASTICS IN ENGINEERING. (Machine Design Series.) By J. Delmonte. Penton Publishing Company, Cleveland, Ohio, 1940. 616 pages, illustrated, $9^1/_2$ by 6 inches, cloth, $7.50. Intended as a reference work for the machine designer and manufacturer, rather than the chemist. Reviews the various types of plastics, methods of compounding, and physical and chemical properties, and discusses methods of molding, uses for bearings, gears, and other machine parts, engineering applications of plastics, fabrication and finishing of plastic parts, common failures, etc. A chapter is devoted to synthetic rubbers.

PROCEDURE HANDBOOK OF ARC-WELDING DESIGN AND PRACTICE. Sixth edition. 1940. Lincoln Electric Company, Cleveland, Ohio, 1940. 1,117 pages, illustrated, 9 by 6 inches, cloth, $1.50 in United States; $2.00 elsewhere. Intended as a reference book on arc welding. The various forms of arc welding are described, welding of various metals explained, and designing of machinery and structures for arc-welded construction discussed. New edition brought up to date and expanded.

PRINCIPLES OF ALTERNATING-CURRENT MACHINERY. (Electrical Engineering Texts.) By R. R. Lawrence. Third edition. McGraw-Hill Book Company, New York, 1940. 678 pages, illustrated, 9 by 6 inches, cloth, $5.50. The principles underlying the construction and operation of the more important types of a-c machinery are treated under eight headings: synchronous alternators, static transformers, synchronous motors, parallel operation of alternators, synchronous converters, polyphase induction motors, single-phase induction motors, and series and repulsion motors. Revised with new material added.

PRINCIPLES OF DIRECT-CURRENT MACHINES. (Electrical Engineering Texts.) By A. S. Langsdorf. Fifth edition. McGraw-Hill Book Company, New York, 1940. 746 pages, illustrated, $9^1/_2$ by 6 inches, cloth, $5.50. Aims to supply a reasonably complete treatment of the fundamental principles that underlie the design and operation of all types of d-c machinery. In addition to the customary revision to bring the material up to date, the present edition includes a more extensive treatment of the general principles of electricity and magnetism, and new sets of problems.

Institute Activities

Institute Publication Procedure Modified to Improve Service

ALTHOUGH the general reaction of the Institute's membership to the present publication policy has been very favorable, operating experience under this policy has indicated that still better publication service could be provided with no net increase in publication expense if certain minor modifications were made.

The two principal adverse criticisms of the present policy are that too many technical program papers are omitted from ELECTRICAL ENGINEERING and that there is too long a delay between presentation of technical program papers and their publication. Also there has been brought to the attention of the publication committee the desire to have abstracts of technical program papers and conference presentations published in advance of conventions and District meetings.

To provide these improvements without involving a net increase in publication expense, the publication committee worked up a set of proposals and these were approved by that committee at its meeting on May 10, 1940. These proposals then were submitted through the chairman of the technical program committee to all members of that committee and to the several hundred members of the Institute's various technical committees. A letter ballot showed a substantial majority in favor of all proposals. Then, at the annual conference of officers, delegates, and members held during the recent summer convention in Swampscott, these same proposals were considered and individually approved either unanimously or by a large majority. Finally the proposals were submitted to and approved by the board of directors at its June 27 convention meeting.

The proposals, which appear in full at the end of this article, provide the following improvements:

1. The publication in ELECTRICAL ENGINEERING of a larger number of technical program papers.
2. A substantial reduction in the time between the presentation of technical program papers and their publication. For example, publication of winter convention papers will begin in January, instead of in May or June.
3. Much earlier publication of the discussions of most of the technical program papers.
4. Advance publication of abstracts of technical papers.
5. Assurance to authors of technical papers approved by the technical program committee and presented at national or District meetings that the papers will be published in ELECTRICAL ENGINEERING if kept within a limit of six printed pages.
6. Increased readability of technical program papers appearing in ELECTRICAL ENGINEERING, secured by encouraging authors to be brief.
7. More orderly and convenient form for the annual bound volumes of TRANSACTIONS. (By the close of the necessary transition period, the annual volume will contain all technical program papers and approved discussion presented during the corresponding calendar year.)

The present modifications involve no change in the following principal features of the publication policy which has been in effect for the last several years.

1. The publication of a substantial number of high-quality general-interest articles in each issue of ELECTRICAL ENGINEERING.
2. TRANSACTIONS a complete repository for all technical papers reviewed and approved for presentation by the technical program committee.
3. Provision of advance pamphlet copies of authors' manuscripts of all technical papers reviewed and approved for presentation by the technical program committee.
4. Provision of the "Transactions Supplement" to ELECTRICAL ENGINEERING, which contains all papers and discussions published in the annual bound volume of TRANSACTIONS which have not been published in the TRANSACTIONS sections of ELECTRICAL ENGINEERING.

Plans are under way in the editorial office to make these modifications as promptly as possible because unless an immediate start is made, the transition cannot be completed in time to have the 1942 bound volume of TRANSACTIONS appear in the more orderly and convenient form.

It is and has been the aim of the publication committee to give Institute members the kind of publication service which they want within the limits set by the AIEE constitution and bylaws, by a high standard of quality, and by a limited publication budget. The comments and criticisms of Institute publications that have been submitted by individual members have been very helpful to the publication committee and to the editor in effecting this aim. Member comments and criticisms of the modifications just adopted will be very welcome. These should be sent either to the editor or to the chairman of the publication committee.

TEXT OF APPROVED PROPOSALS

PROPOSAL A: Provide for early publication of abstracts of approved technical program papers, for publication of approved abstracts of unapproved technical program papers or presentations and for separate "abstract bulletin."

Explanation: This is an extension of the present publication policy which now provides for the publication of authors' abstracts of approved technical program papers. The extension would comprise:

1. The immediate publication in ELECTRICAL ENGINEERING of the abstracts of approved papers separate from the papers themselves as soon as possible after the release of the manuscript for preparing "advance copies."
2. The publication of approved abstracts of unapproved papers or presentations such as (*a*) District meeting papers not reviewed and approved by the technical program committee and (*b*) informal conference presentations.
3. The publication of an "abstract bulletin" to be mailed with convention or meeting programs to include abstracts released too late to get in ELECTRICAL ENGINEERING in advance of the convention or meeting but in time to be mailed with the program.

PROPOSAL B: Limit advance pamphlet copies of authors' manuscripts to those reviewed and approved by the technical program committee.

Explanation: This is merely a confirmation of the present publication policy put into effect at the time when the present form of advance pamphlet copies was adopted. The reasons back of this policy are:

1. The Institute should not publish under its name material that has not been properly reviewed and approved.
2. The Institute's limited publication budget should be conserved as far as possible for uses which benefit our whole membership rather than only very small groups. (Even with the increased prices proposed for advance pamphlet copies, they would not be nearly self-supporting.)

PROPOSAL C: Reduce the net cost of providing advance pamphlet copies of authors' manuscripts reviewed and approved by the technical program committee by putting these on a more nearly self-supporting basis.

Explanation: The cost of some of these pamphlet copies approximates 50 cents each, the bulk of them costing from 10 to 25 cents each (not including postage and handling). The following price schedule is proposed:

Size of Pamphlet (Pages)	Price Per Copy	
	At Registration Desk	By Mail
12 or less	$0.10	$0.15
16	.15	.20
20	.20	.25
24 or more	.25	.30

(This price schedule is not retroactive. It is expected to go into effect October 1, 1940.)

Even at these increased prices the net cost to the Institute would be several thousand dollars per year. While these pamphlet copies fill an expressed and important need, they serve a relatively small portion of our total membership and hence the cost to the general membership should be kept at a minimum. Additional income from the sale of these pamphlet copies would permit the publication of more material in ELECTRICAL ENGINEERING and TRANSACTIONS without increasing the total net publication expense.

PROPOSAL D: Omit discussions from Electrical Engineering and publish these semiannually in two "Transactions Supplements."

Explanation: This proposal has three objects:

1. To reduce substantially the time between presentation and publication. For instance, under the present arrangement, the publication of winter convention papers does not start until the May issue of ELECTRICAL ENGINEERING, while under the proposed arrangement publication would start with the January issue and be completed with the June issue; a gain of four months.
2. To provide for publishing more technical program papers in the TRANSACTIONS section of ELECTRICAL ENGINEERING. Discussions now require over 20 per cent of the pages. By omitting discussions, these pages could be used for additional papers without increase in publication expense.
3. To make the bound volumes of TRANSACTIONS more orderly and more convenient to use. For instance, with the proposed arrangement in effect, the bound volume of TRANSACTIONS, dated 1942, would contain all approved technical program papers presented in 1942. Under the present arrangement, each volume is a mixture in this respect.

The discussions of all winter convention papers would be published in the first semiannual issue of the "Transactions Supplement" which would come out in June of each year. While a small part of the winter convention discussions (that now appearing in the May issue of ELECTRICAL ENGINEERING) would be delayed for one month, all discussions of winter convention papers would be published in June so that most of the discussions would be published considerably earlier than is the case under the present arrangement. Each paper having discussion would carry a footnote indicating in which issue of the "Transactions Supplement" the complete discussion could be found. The discussions for the whole year would appear all together in the corresponding bound volume of TRANSACTIONS.

PROPOSAL E: Place page limit (six pages in type) on technical program papers to appear in the Transactions section of Electrical Engineering.

Explanation: This proposal has two objects:

1. To provide for publishing more technical program papers in the TRANSACTIONS section of ELECTRICAL ENGINEERING without increasing publication expense.

2. To place directly within the control of the author the primary consideration on which the decision to publish or not to publish in ELECTRICAL ENGINEERING would be based.

Mere suggestions to authors to be brief have not produced the desired results even though in a great many cases brevity would increase the quality and value of papers. It is expected that the proposed procedure would be much more effective. It is not intended to omit all papers that exceed the limit, but rather to assure publication in ELECTRICAL ENGINEERING of all approved papers that do not exceed the page limit. With this and the other proposals in effect, many of the longer papers also would appear in ELECTRICAL ENGINEERING, but authors would know in advance that papers exceeding the page limit might not appear there.

For convenience to them, the limit would be stated to the authors in terms of number of words and the equivalent number of words for each column-inch of illustrations.

PROPOSAL F: Remove restriction set by publication budget on the number of papers which may be approved by technical program committee.

Explanation: There is in fact no such actual restriction at the present time because the publication budget has been made up to provide for the space that the technical program committee has estimated would be needed on the basis of the established publication policy. Also other limitations are present, viz., the number of papers that can be handled satisfactorily in one session, the number of parallel sessions that can be handled separately, and the availability of actual manuscripts of papers of sufficiently high quality, etc. There is, of course, a limit to the size of the budget which the publication committee can have approved by the board of directors because our total income is necessarily limited. However, the removal of the publication-budget restriction should clarify the situation and avoid any conflict, real or apparent, between the activities of the two committees. With the publication-budget restriction removed from the technical program committee schedules, only the publication committee activities would be restricted by the publication budget. That would seem to be the logical arrangement.

With this modification in effect there would be no change in the present technical program committee procedure which is as follows:

1. Review and approve or disapprove all technical papers submitted for program consideration.

2. Arrange desirable national convention programs using only approved papers which are considered suitable for presentation. Also furnish approved papers to the local committees arranging District meeting technical programs.

3. Deliver to publication committee all approved papers whether scheduled for presentation or not.

The procedure in the publication committee would not differ in any general way from the present one but the proportion of the total number of technical-program-committee-approved papers appearing in ELECTRICAL ENGINEERING would vary depending upon the available budget. However, with proposed changes *C*, *D*, and *E*, above, in effect, the number of such papers appearing in ELECTRICAL ENGINEERING would be increased without any increase in publication budget. Specifically publication committee procedure would be:

4. Publish in TRANSACTIONS all technical papers (and discussions of them) approved by Technical program committee.

5. Publish in TRANSACTIONS section of ELECTRICAL ENGINEERING without discussions as many technical papers approved by technical program committee as publication budget permits.

6. Publish in two semiannual issues of the "Transactions supplement" the discussions of all approved technical papers presented at national conventions or District meetings. Also publish in the "Transactions Supplement" those approved technical papers presented at national conventions and District meetings which are not published in the TRANSACTIONS section of ELECTRICAL ENGINEERING.

7. Provide pamphlet copies of all technical papers approved by technical program committee in accordance with price schedule under C above.

As a guide to the publication committee, the technical program committee would be asked, near the close of each appropriation year, to *estimate the number of papers* it would approve during the next appropriation year, but this estimate would place no restriction on the technical program committee as to the number of papers it actually would approve.

Technical Program—Pacific Coast Convention

Photo-offset copies of authors' manuscripts, except addresses, may be obtained as soon as available in advance of the convention by writing to the AIEE order department, 33 West 39th Street, New York, N. Y. Only numbered papers will be available in advance-copy form. If ordered by mail, price 10 cents per copy; if purchased at Institute headquarters or at the convention, 5 cents per copy. Mail orders (particularly from out-of-town members) are advisable, as an adequate supply of each paper at the meeting cannot be assured. Coupon books in $1 and $5 denominations are available for those who wish to avoid remittance by check or otherwise. Most of the papers ultimately will be published in ELECTRICAL ENGINEERING or the TRANSACTIONS.

Tuesday August 27

10:00 a.m. Opening Session

Address of welcome. N. B. Hinson, convention chairman

Address, "Science and Superstition." R. W. Sorensen, president, AIEE

Address. Douglas Shearer, sound director, Metro-Goldwyn-Mayer Studios

2:00 p.m. Protective Devices

40-127. AN IMPROVED A-C PILOT WIRE RELAY. **J. H. Neher**, Philadelphia Electric Company, and **A. J. McConnell**, General Electric Company

40-115. DISPLACEMENT AND DIFFUSION IN FLUID FLOW ARC EXTINCTION. **Joseph Slepian**, Westinghouse Electric and Manufacturing Company

40-114. THE VERTICAL FLOW INTERRUPTER AND ITS APPLICATION TO OIL-POOR CIRCUIT BREAKERS. **B. P. Baker**, Westinghouse Electric and Manufacturing Company

40-129. POSSIBILITIES AND METHODS OF EXTENDING A CARRIER-CURRENT RELAY CHANNEL TO OTHER USES. **R. M. Smith** and **S. L. Goldsborough**, Westinghouse Electric and Manufacturing Company

Wednesday, August 28

9:00 a.m. Power Transmission and Distribution

40-133. SUPERPOSITION METHODS IN CALCULATING EFFECTS OF ADDITIONS TO POWER SYSTEMS. **V. G. Rettig**, Cincinnati Gas and Electric Company

40-126. CAPACITORS AND CIRCUIT PERFORMANCE. **J. W. Butler**, General Electric Company

40-107. SHIELDING OF TRANSMISSION LINES. **C. F. Wagner, G. D. McCann**, and **G. L. MacLane, Jr.**, Westinghouse Electric and Manufacturing Company

40-134. A DOUBLE-BREAK OIL- OR GAS-BLAST POWER FUSE. **G. Leslie Hill**, Pacific Gas and Electric Company

9:00 a.m. Conference on Governors, Frequency Control, Load Swings, etc.

2:00 p.m. Electrical Machinery

40-132. AN ELECTRICAL GOVERNOR. **Frank I. Morgan**, Pennsylvania Water and Power Company

40-130. POWER-FACTOR TESTING OF TRANSFORMER INSULATION. **J. B. Hodtum**, Allis-Chalmers Manufacturing Company

40-120. SOME ACCELERATION TESTS ON LARGE SYNCHRONOUS PUMP MOTORS. **R. W. Ager**, University of California

40-135. A GENERALIZED EQUIVALENT CIRCUIT IN THE THEORY OF POLYPHASE COMMUTATOR MOTORS. **W. B. Coulthard**, University of British Columbia.

2:00 p.m. Instruments, Measurements, and Basic Sciences

40-108. TRANSIENT ANALYSIS OF COMPLETELY TRANSPOSED MULTICONDUCTOR TRANSMISSION LINES. **Louis A. Pipes**, Harvard University

40-128. BRAKING MAGNETS FOR WATT-HOUR METERS. **I. F. Kinnard** and **J. H. Goss**, General Electric Company

40-136. VARIO-LOSSER CIRCUITS. **W. R. Bennett** and **S. Doba**, Bell Telephone Laboratories

40-131. BEHAVIOR OF POINT GAPS AT 60 CYCLES. **Jean V. Lebacqz**, University of California.

2:00 p.m. Student Technical Session

PRIEST RIVER POWER DEVELOPMENT. **Albert Kassens**, University of Idaho

THE MEASUREMENT OF REACTIVE VOLT-AMPERES BY MEANS OF SYMMETRICAL COMPONENTS. **Charles B. Lee**, University of Washington

ELECTRICAL DETERMINATION OF WATER-FLOW CONTOURS. **Carl J. Bratfisch**, University of Southern California

A STUDY OF ARC-EXTINGUISHING PHENOMENA. **Don J. Nairn**, University of Southern California

CONSTRUCTION OF A 2,000,000-VOLT IMPULSE GENERATOR. **W. R. Johnson**, Stanford University

Thursday, August 29

9:00 a.m. Communication—Joint Session With IRE

Address, "Frequency Modulation." Major E. H. Armstrong

Address. Speaker to be announced.

2:00 p.m. Student Technical Session

A ONE-METER REPLICA GRATING SPECTROGRAPH. **Joseph Mitch**, Montana State College

AN IMPROVED-TYPE LOSSER MODULATOR. **V. S. Carson**, Stanford University

A STABILIZED NEON-TUBE COUPLED AMPLIFIER. **W. H. Huggins**, Oregon State College

DESIGN OF A RADIO-FREQUENCY PHASE METER. **T. L. Wilson** and **C. R. Knight**, University of Utah

PERMEANCE OF TAPERED SLOTS IN ELECTRICAL MACHINES. **T. S. Wang**, California Institute of Technology

Program Completed for Pacific Coast Convention

All is in readiness for the 1940 Pacific Coast convention to be held in Los Angeles, Calif., August 27–30. An attractive program of technical and recreational features, which leaves little to be desired, has been arranged by the committee. Southern California by virtue of its proximity to the mountains and the sea offers many vacation possibilities. Convention headquarters will be at the Ambassador Hotel, which has excellent facilities.

Information on the various features of the convention, technical sessions, student activities, entertainment, sports, inspection trips, registration and hotels, as well as a complete schedule of events, was given in ELECTRICAL ENGINEERING for July, pages 288–9. The technical program, comprising five technical sessions, a technical conference, and two student technical sessions, is presented on the preceding page.

56th Annual Summer Convention Held in Swampscott, Mass.

FOR the third time in Swampscott, and for the eighth time in New England, the Institute's summer convention was held at the New Ocean House, Swampscott, Mass., June 24–28 inclusive. Previous Swampscott conventions were held in 1923 and in 1929. Other AIEE summer conventions held in New England include Boston, Mass., 1890; Eliot, Me., 1897; Boston, Mass., 1899; Great Barrington, Mass., 1902; Boston, Mass., 1912.

Registered attendance this summer at Swampscott, as may be noted from the accompanying tabulation, totaled 1,014, substantially above the over-all average of 822 for the period 1920–39. Other details pertaining to the great variety of convention activities may be found on the following pages.

Annual Business Meeting

In convening the Institute's official annual meeting at 10 o'clock Monday morning, June 24, in the ballroom of the New Ocean House, General Convention Chairman J. I. Hull gave voice to a convention theme:

"As I face this convention, I sense a conference of an outstanding part of the American engineering brotherhood. You are here to report progress, to confer, to preview, and to guide the future. Nobody assigned to you your roles as engineers, teachers, industrial practitioners. Through parental counsel or contact or study, you made your youthful comparisons, mapped your courses, and now you are actually living them. In following our calling as engineers, we partake of the bounty of America, of the bounty of abundant nature whose resources are ready to serve him who will rightly fashion and cleverly contrive; the bounty of abundant calling to be called to one's likings and abilities; of abundance of amiable people with whom to live and work in friendship and co-operation; the abundance of opportunity to make a contribution of usefulness to better America for ourselves and for the future."

Chairman Hull successively introduced the Honorable Frederick Cook, Secretary of State for the Commonwealth of Massachusetts, who spoke briefly on behalf of Governor Saltonstall; AIEE Vice-President C. L. Dawes of Harvard University, who elaborated on the points of scenic, technical, and historical interest to be found in the vicinity; and President F. Malcolm Farmer who presided for the business session. President Farmer gave special recognition to the effective work of the various convention committees.

REPORTS OF THE BOARD OF DIRECTORS AND THE COMMITTEE OF TELLERS

An abstract of the annual report of the board of directors for the fiscal year ending April 30, 1940, was presented by National Secretary H. H. Henline in accordance with custom.

Although previously organized Sections so thoroughly covered the country that the early organization of new Sections seemed improbable, three new Sections were authorized and went into operation during the year: Charleston, W. Va.; El Paso, Texas; and the State of South Carolina. Also, one new Branch was formed, at the University of Alberta; this brings the present total to 70 Sections and 121 Student Branches. All Sections reported some activity during the year.

For the sixth consecutive year, the number of Section meetings reported increased, from a total of 635 the preceding year to a total of 701 for the year recently ended. In addition to District meetings and national conventions, there was a total of more than 2,000 Section and Branch meetings, with an average reported attendance of more than 78 per meeting. The Institute membership grew during the year from 16,605 to 17,213, some 6 per cent below the predepression level compared with 22 per cent for the depression low point.

Secretary Henline emphasized the fact that the annual report of the board of directors is presented to the membership each year in conformity with the constitutional requirements that the board shall report to the membership at the close of the fiscal year, April 30, upon the activities, the properties owned, the income, the expenditures, and all other essential facts bearing on the status of the Institute. He pointed out that this report actually is a series of many brief reports from the various responsible committees, that it contains information of interest and value to every member of the Institute, and that it had been distributed to the entire membership of the Institute through the medium of the July issue of ELECTRICAL ENGINEERING (pages 290–303 inclusive). Also, the few brief facts pertaining to Section and Branch activities are but a summation of the detailed information given on pages 250–3 inclusive of the June issue.

Upon presentation of the tellers' report by National Secretary Henline, President Farmer declared the new officers elected and charged with the responsibility of beginning their administrative term August 1, 1940. He officially inducted President-Elect Sorensen into office, and made the traditional presentation of the president's badge. For the substance of the tellers' report, and the list of new Institute officers, see page 289 of the July issue of ELECTRICAL ENGINEERING.

TREASURER'S REPORT

Summarizing the detailed report contained in the report of the board of directors, Treasurer W. I. Slichter reported that Institute income for 1939–40 was some $292,914 as compared to some $280,144 for the preceding year; that Institute activities, and consequent expenses, had been increased in about the same proportion for the benefit of the membership at large. As to the capital reserve (emergency savings) fund, Treasurer Slichter reported that the present total reserves amount to some $240,494; that in terms of market value May 1, 1940, securities in hand have a cash value of more than 90 per cent of their book value, representing relatively a very favorable position.

PRIZE AWARDS

Acting for Chairman J. W. Barker of the committee on award of Institute prizes, I. Melville Stein, a member of the committee, read a report covering the national awards made for technical papers presented during the calendar year 1939. The substance of this report was published on page 254 of the June 1940 issue of ELECTRICAL ENGINEERING; similarly, District prize paper awards were published in the July issue, pages 304–05.

On behalf of the committee, Mr. Stein called attention to the lack of papers of national prize caliber on the subject of public relations, and urged the development of more papers within the scope of that important subject. With reference to the subject of Student Branch papers, Mr. Stein emphasized that although there usually are enough for a satisfactory competition for the national prizes, it was the consensus of the committee that many good Student Branch papers are being written

Analysis of Attendance at 1940 Summer Convention, Swampscott, Mass.

Classification	Districts 1	2	3	4	5	6	7	8	9	10	Foreign	Totals
Members	280	110	127	25	62	4	20	10	8	7	1	654
Men guests	57	18	18	2	8		3		2	1		109
Women guests	87	45	38	14	36	5	13	7	4	2		251
Totals	424	173	183	41	106	9	36	17	14	10	1	1,014

and presented each year that do not get through the District channels into the national competition, at least in certain Districts. He emphasized the committee's hope "that a much larger number of Student Branch papers will be presented each year for the national competition."

President Farmer made the prize awards to those prize winners who were present.

CHARTER MEMBER CHARLES L. CLARKE RECEIVES SPECIAL HONORS

In recognition of the fact that he is a sole survivor from among the 71 leaders of their time who on May 13, 1884, organized the American Institute of Electrical Engineers, special honors were accorded to Charles Lorenzo Clarke (A'84, F'12) of Newton, Mass. This was a special feature of the annual meeting. On behalf of the Institute, President Farmer presented to Mr. Clarke a scroll bearing the inscription "The Members of the American Institute of Electrical Engineers assembled in convention at Swampscott, Mass., June 24–28, 1940, hereby convey to Charles Lorenzo Clarke, sole surviving charter member, their appreciation of his long-continued association with the Institute, and extend to him their felicitations and best wishes."

Obviously deeply moved, but apparently in good health and spirit in spite of his 87 years, Mr. Clarke in accepting the scroll from President Farmer responded as follows:

"Mr. President and brothers of the American Institute of Electrical Engineers. It is a heartfelt pleasure to receive this welcome and testimonial from my professional associates, which I take not only for myself, but in spirit for the other 70 charter members, now gone, by whom the Institute was founded on April 15, 1884; became operatively organized on May 13; and began functioning at its first convention in October of the same year during the International Electrical Exhibition at Philadelphia.

"The faithfulness and ability with which the affairs of the Institute have been conducted for the good of its members, during the 56 years of its life, and the resulting benefits to mankind, are reflected in the increase in members from the original 71, until now they number more than 15,000 in this country alone, and exceed 17,000 altogether; while the benefits are obvious on every hand throughout the world and too vast to be recounted.

"The Institute was founded and has prospered to its present highly useful estate under the fostering protection of a government in a land of freedom bequeathed to us by our forefathers. May those who succeed us continue its growth and usefulness under like conditions.

"I wish for you all a continued well-being consonant with your own just good, also for the good of the AIEE, and above all for the good of our country."

AIEE 1939 LAMME MEDAL PRESENTED TO NORMAN W. STORER

"For meritorious achievement in the development of apparatus and machinery for electrical transportation," the 12th AIEE Lamme Gold Medal was presented to Norman W. Storer (A'95, F'13) retired consulting railway engineer of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. President Farmer made the presentation to Mr. Storer as a feature of the annual meeting. Preceding the actual presentation, Chairman W. B. Kouwenhoven of the Lamme Medal committee reviewed the background of the award, and A. M. Dudley, acting for C. A. Powel of the committee, outlined the career of Medalist Storer. Essentially full text of these various presentations will be found elsewhere in this issue.

Recent Summer Convention Attendance

1940	**Swampscott, Mass.**	*(1)	**1,014**
1939	San Francisco, Calif.	(8)	940
1938	Washington, D. C.	(2)	825
1937	Milwaukee, Wis.	(5)	1,067
1936	Pasadena, Calif.	(8)	715
1935	Ithaca, N. Y.	(1)	904
1934	Hot Springs, Va.	(4)	351
1933	Chicago, Ill.	(5)	968
1932	Cleveland, Ohio	(2)	1,022
1931	Asheville, N. C.	(4)	525

* District numbers in parentheses.

Other Lamme Medal Awards. In addition to the Institute's award, the late Benjamin Garver Lamme provided for similar awards to be made by the Society for the Promotion of Engineering Education, and by Ohio State University.

The SPEE Lamme Medal for 1939 was awarded to Doctor Andrey Abraham Potter, dean of the schools of engineering and director of the Engineering Experiment Station at Purdue University, "for his leadership in the advancement of the profession of engineering; for his devotion to high standards of teaching and his contributions to the development of engineering education; for his understanding of human nature and sympathetic interest in the work of his associates and students, for his sound judgment and skill as an engineer, and for his untiring efforts in developing co-operative relations between engineering colleges and industry."

The Ohio State University Lamme Medal for 1939 is awarded each year to an alumnus of the University who distinguishes himself in the field of engineering. The 1939 award was made June 10 at commencement exercises to Lawrence Eugene Barringer, engineer in charge of insulations of the General Electric Company, Schenectady, N. Y.

PRESIDENT'S ADDRESS

President Farmer's interesting and illuminating address on the subject of "Standardization and the Institute," presented at the annual meeting, is scheduled for publication in full in an early issue of ELECTRICAL ENGINEERING.

Other Convention Features

The ten technical sessions of the summer convention program proceeded approximately as scheduled in the June issue of ELECTRICAL ENGINEERING. Six technical conferences featured the program; reports of five of these are given elsewhere in this issue. The report of the convention meeting of the Institute's board of directors also appears elsewhere.

FORUM HELD JOINTLY WITH AEC

Continuing the popular procedure of recent years, a "general session" was provided in the Swampscott program, this time with the active collaboration of American Engineering Council under the leadership of its president Colonel Alonzo J. Hammond. All of Thursday forenoon was devoted to this session, and no other sessions were held in parallel. Speaking from opposing viewpoints on the session topic "Transportation as a Social Problem," Colonel William J. Wilgus and Colonel Robert F. Henry held the absorbed interest of a heavily attended meeting.

Colonel Wilgus, well-known consulting engineer and former vice-president and chief engineer of the New York Central Railroad, sincerely and effectively spoke in behalf of government operation of all railroads, on general principles but especially as an allegedly vital factor in national defense. Colonel Henry, assistant to the president of the Association of American Railroads and a lawyer by profession, presented a compelling argument in support of continuing the American ideal of free enterprise and individual responsibility, with special reference to the railroads. Sentiment at Swampscott was strongly in support of Colonel Henry's position. The texts of both these challenging addresses are scheduled for publication in an early issue of ELECTRICAL ENGINEERING.

ENTERTAINMENT AND SPORTS

In spite of prevailing inclement weather which interfered with scheduled outdoor activities, conventioneers were kept busy and happy during otherwise leisure moments by the programs provided by the local committees. These included sailing, boat races, and trips to any of the numerous nearby points of scenic, historic, or technical interest.

Principal feature of the general entertainment program was a banquet dance held Thursday evening in the enormous main dining room of the New Ocean House. There, Past Vice-President William H. Timbie gave one of his inimitable performances as toastmaster, and addresses were given by President Karl T. Compton of Massachusetts Institute of Technology and Laurence A. Hawkins, executive engineer of the General Electric Company's Research Laboratory. President Compton pointed out the glaring necessity for effective national defense measures as compared with those that actually have been carried out by Federal Government administrative agencies during recent years, and criticized the failure to accumulate adequate supplies of strategic metals necessary for national defense. Mr. Hawkins emphasized the importance of research and engineering as vital elements in effective national defense developments. His address is scheduled for early publication in ELECTRICAL ENGINEERING.

Although a wealth in value and variety of prizes was provided by the local committees, the pressure of other convention activities combined with discouraging weather greatly reduced the participation in the various competitions. Winners in the principal events were as follows:

The Mershon Golf Trophy, available for national competition among Institute members on the basis of match play and handicap, was won by H. A. McCrea of Boston, Mass.; H. E. Wulfing of Chicago was runner up. Mr. McCrea thus becomes the fifth member to have his name engraved upon the present trophy, which is the third cup donated by Past President Ralph Mershon. This trophy remains on display at Institute headquarters.

The Lee trophy, presented in 1932 by the late Past President W. S. Lee, is awarded each year to the member having the lowest net score for 36 holes, and must be won twice by the same player for permanent possession. At Swampscott, Mr. Wulfing won the Lee trophy, and Mr. McCrea and C. H. Sanderson of New York were tied as runners up. Mr. Wulfing is the eighth member to win a leg on the cup, and the privilege of having his name engraved on it.

In the tennis competitions, C. B. Oler of New York won the Mershon Trophy for men's singles, with L. T. Shilzneck of Lynn, Mass., as runner up. The mixed-doubles competition was won by Mr. and Mrs. F. J. Groat of New York, Mrs. Groat winning also the women's singles. Other competitions featuring attractive prizes included a wide variety of golfing events for men and women, a horseshoe-pitching tournament, a bowling tournament, a table-tennis tournament, and yacht races. In the last-mentioned, crews of the boats participating were made up of AIEE members from among the convention group, although the nonmember owners received the prizes.

Annual Conference of Officers, Delegates, and Members Held at Swampscott, Mass.

To provide more time for the discussion of Institute affairs, the first three afternoons of the convention week this year were devoted to the sessions of the annual conference of officers, delegates, and members. The conference was held under the joint sponsorship of the AIEE committees on Sections and Student Branches, the Monday and Wednesday afternoon sessions being devoted to Section and general matters with Chairman H. H. Race of the Sections committee presiding, and the Tuesday afternoon session to Student Branch matters with Chairman R. W. Sorensen of the committee on Student Branches presiding.

Attendance at the Monday and Wednesday afternoon session averaged about 100 and the attendance on Tuesday afternoon was about 40. There were present delegates from 66 of the Institute's 70 sections, 9 of the 10 District secretaries, counselor delegates from 8 of the 9 Districts in which committees on student activities have been organized, and others interested in the Institute's organization affairs. The Erie, Mexico, San Antonio, and Saskatchewan sections were not represented. The secretary of District 9 was not present and no counselor delegate was present from District 3.

The program for the conference sessions was carried out as follows:

Monday Afternoon, June 24, 2:00 p.m.

Opening remarks—President F. Malcolm Farmer

1. Report on meeting of Sections committee held in New York, January 23, 1940, M. S. Coover, secretary
2. Term of Student enrollment, and election to regular membership, W. G. Knickerbocker, chairman, Michigan Section
3. Publication policies, I. Melville Stein, chairman, publication committee
4. Procedure in connection with applications for Fellow grade, A. E. Knowlton, vice-chairman, board of examiners

Tuesday Afternoon, June 25, 2:00 p.m.

Conference on Student Branch activities

Wednesday Afternoon, June 26, 2:00 p.m.

1. Status of the proposed Model Law for licensing engineers, C. R. Beardsley, chairman, committee on legislation affecting the engineering profession
2. Section activities—summaries of questionnaires, R. M. Pfalzgraff and W. B. Morton
3. Miscellaneous Section problems
   - *a.* Junior engineer activities, F. Ellis Johnson, chairman, committee on education
   - *b.* Problems incident to the formation of sub-Sections
   - *c.* Methods for serving members who live far from the usual Section meeting places
   - *d.* Methods for welcoming new members and making them "feel at home"
   - *e.* General discussion of Section activities

Before introducing President Farmer, Chairman Race especially welcomed delegates from the Institute's new Sections (Charleston, El Paso, South Carolina).

In his brief remarks of greeting, President Farmer emphasized the importance of these summer-convention conferences to the success of the Institute's activities, and reminded the delegates of their responsibility both as representatives of their several Sections and as individual leaders in Institute activities. He cited the conference as constituting one of the Institute's channels of contact with its individual members, other channels being represented by the national officers periodically elected from among the membership in the various Districts.

Professor Coover reported that the interim activities of the Sections committee were adequately reflected in reports already published in ELECTRICAL ENGINEERING.

STUDENT ENROLLMENT

The discussion of the topic of student enrollment—the length of time following graduation for which Institute affiliation as an Enrolled Student should be allowed to continue—centered primarily around the question of some special provision to take care of midyear graduates. It was the general consensus that present membership regulations adequately provide for the June graduate by giving him nearly a year (until the following May 1) for the continuance of his student status. Opinions, however, did favor some modification of regulation more equitably to accommodate Enrolled Students graduated at times other than June, particularly the February or midyear group. A special committee appointed at the Monday session by Chairman Race to consider this question and to draft appropriate recommendations brought in the following recommendation:

> "To provide equal privileges for those students who graduate at some time other than at the end of a regularly recognized year, the committee recommends that this meeting ask the board of directors to rule, or if necessary to have the bylaws amended, so that the student status of those graduating during the regular academic year can be considered to continue until the end of the regularly recognized academic year, thus entitling such students to the privileges enumerated in sections 53 and 57 of the bylaws covering Institute student enrollment and transfer to Associate membership."

This recommendation, having in the meantime been discussed and approved by the intervening conference session on student activities, was unanimously adopted. It was approved by the board of directors on June 27.

PUBLICATION POLICIES

Chairman I. Melville Stein of the publication committee presented a digest of certain proposals that have been approved by the publication committee and recommended for adoption for the improvement of the Institute's publication services to its members. Following an explanation by Mr. Stein of the nature and significance of these proposals, and a fairly detailed discussion of them from the floor, each of the several proposals was separately voted upon and endorsed either unanimously or by a substantial majority. As these same proposals subsequently were approved by the board of directors at its Swampscott meeting June 27, a full and detailed exposition of them will be found elsewhere in this issue.

FELLOW-GRADE APPLICATIONS

At the request of the Sections committee, and on behalf of the AIEE board of examiners, Vice-Chairman A. E. Knowlton of the board of examiners presented before the conference a comprehensive explanation of the procedure required of the board of examiners by the current constitutional and bylaw requirements relating to membership applications, especially with reference to transfer to the grade of Fellow. Current discussion of this general subject seems to center around the insistent proposal from some active Sections that modifications should be made in the procedure with reference to the transfer to Fellow grade that would permit local Section groups to handle such transfers on an invitational or proposal basis without the knowledge or participation of the proposed transferee. This has given rise to requests for "informal" reviews and advance tentative decisions on the part of the board of examiners. Any such "informal" preliminary actions on the part of the board of examiners were clearly shown by Mr. Knowlton to be contrary to existing constitutional and bylaw requirements. Mr. Knowlton pointed out that "if the constitution were to be changed to accord with the objectives of those who desired to see an increase in membership of the Fellow grade, the board of examiners would, of course, then set up rules and practice which would carry out the literal instructions of the recognized intent of the revised constitution."

Following an extended discussion of various aspects of this question, Chairman Race appointed a special committee to confer with Mr. Knowlton incidental to the preparation of some specific proposal embracing the expressed desires of the various delegates. This committee reported at the Wednesday session, not with specific recommended proposals, but with a variety of possible modifications, presented for the purpose of drawing out the views and opinions of the various delegates. Further and extensive discussion ensued, leading ultimately to a divided vote recommending to the board of directors that an appropriate committee be appointed to give further and specialized study to the matter of membership requirements relating to transfers to grade of Fellow and to report to the Sections committee subsequently concerning their findings and recommendations. Following this action an informal show of hands indicated a large majority to be in favor of providing two parallel avenues for transfer to grade of Fellow: (*a*) by direct application of the individual as it was until two years ago, and (*b*) by invitation resulting from sponsorship of five Fellows who could furnish a complete record for the board of examiners without requiring the individual's knowledge or signature. (Subsequently, the board of directors referred the question to the board of examiners "for consideration and report.")

SECTION ACTIVITIES

To facilitate the exchange of useful information between Sections, C. A. Faust of Mansfield, Ohio, recently prepared and circulated to all Sections on behalf of the Sections committee a questionnaire concerning Section activities. Of the 70 Sections receiving this questionnaire, 54 were sufficiently interested to respond to it. These responses have been co-ordinated and summarized on behalf of the Sections committee by W. B. Morton of the Philadelphia Section and R. M. Pfalzgraff of the Lynn Section. For information and discussion, these summaries in mimeographed form were distributed to delegates at Swampscott. A digest of the salient points probably will be included in an early issue of ELECTRICAL ENGINEERING, and subsequently it is planned to incorporate the information into a revised edition of the booklet on Section activities which, in due course, will be available to Section officers and others interested.

The formation of sub-Sections is one of the most promising activities for promotion of interest, especially in territories having several centers of membership concentration. Several sub-Sections or joint-sub-Sections are being considered.

LICENSING OF ENGINEERS

Concerning the present status of the proposed Model Law for the licensing of engineers, and of the engineering-license situation in general, Chairman Race read the following communication from C. R. Beardsley, chairman of the AIEE committee on legislation affecting the engineering profession:

"There have been no outstanding developments in the matter of licensing in recent months except that several individual states are drafting laws through engineering committees on which we are represented; for example, California, Missouri, Illinois, and Massachusetts. Some of the ideas and provisions of the Model Law are being worked into these laws where applicable, so that I don't think our work has been entirely in vain.

"What I am most concerned about is this matter of individual Sections following the legislation in their own states as we are doing in New York, so that amendments when proposed may have scrutiny, and support or opposition as may be desirable. . . . The national committee cannot attempt to keep posted on the activities in 48 states and it is only by Sections' activity that this matter may be given the attention that it deserves."

(In connection with this President Farmer had written a letter on April 26 to Section chairmen in which he again urged them to appoint committees on legislation charged with keeping informed on proposals in their states, to present the facts to their membership, and to inform the national committee on legislation and developments.)

"We have received quite a bit of comment and suggestion for alteration to the Model Law, but have not wished to be premature in making a revision. However, we propose to do that ultimately. It is quite possible that after the American Engineering Council gets reorganized, it may be possible to formalize the representations by other engineering societies and work toward a more uniform Model Law composing some of the difficulties and divergencies which now exist."

SECTION AID TO JUNIOR ENGINEERS

Serious consideration is being given by Engineers' Council for Professional Development and by the professional societies to plans for helping junior or young engineers advance in the profession during the first two years after graduation. Thinking that specific programs for their education and development would be welcomed by such young men, and that possibly various Sections of the AIEE might take the leadership for this work in each locality, the Institute's committee on education recently circulated to all Sections a questionnaire concerning related policy, opinions, and procedure. This project was handled by a special subcommittee consisting of L. W. W. Morrow and K. W. Miller of Chicago, who on behalf of the committee on education, provided a mimeographed report for the edification of the delegates at Swampscott, summarizing the 52 responses that were received from Sections. High lights of this subcommittee's conclusions are as follows:

"It is apparent that Sections, as a whole, have not developed a special program for the development of junior engineers. It is apparent also that each Section is a specific case and that any general program must fit into the conditions each Section encounters.

"Opinions about specialized activities for junior engineers are not positive as to its need, its value, or its reception by junior engineers. It seems obvious that the start of any such work can best be made by having junior engineers participate more actively in regular Section activity. Organized efforts to bring about personal contacts, to get young engineers on committees, to develop some form of paper competition or debates, and to stimulate them to discussion at Section meetings will bring results and possibly, except in special cases, this is as far as Sections can and should go in this work.

"Efforts of Sections to give educational work directly do not appear to be warranted because of the availability of courses already being given by educational institutions and it seems more advisable for Sections to stress the social and professional aspects of development of juniors by having them participate actively in regular Section activities.

"One of the best systems discovered lies in having a senior engineer sponsor a junior engineer. The senior engineer takes the junior to the meeting with him and often invites him to dinner before the meeting and serves as a counselor to the junior. Within limits, this seems to be a splendid activity for Sections to cultivate. . . ."

General discussion of this subject soon broadened out to include a wide range of miscellaneous Section operating problems, but led to no further action.

COUNSELOR-DELEGATE SESSION

A full afternoon session was devoted to the annual conference of Student Branch counselors and others interested in Student Branch work, this constituting one of the three sessions of the official annual conference of officers, delegates, and members. President-Elect R. W. Sorensen presided as chairman of the Institute's committee on Student Branches.

Safety. Emphasizing to Student Branch counselors the importance of adequate safety instruction for engineering students, Frank Thornton, Jr., of Pittsburgh, Pa., reported as follows on behalf of the Institute's committee on safety:

"The national committee on safety of the AIEE believes that students of electrical engineering should become better informed regarding the problems of safe construction, maintenance, and operation of electrical apparatus and equipment. To this end the committee recommends that every Student Branch of the Institute hold one or more meetings during the school year on the subject of electrical safety. Consideration of safety enters into every step of the electrical-engineering field. Extremely interesting discussions can be arranged on the safety provisions in the design of apparatus, the safe methods of installation, safe practices in operation and use of equipment, and on first aid in case of accidents."

That each Branch may have a guide in developing effective meeting programs on the subject of safety, Mr. Thornton reported that his committee is preparing material and recommendations that are intended to be forwarded early this coming fall to the chairman and counselor of each Student Branch. A motion was adopted unanimously urging every Branch to give serious attention to this important topic.

Prize Regulations for Student Branch Papers. Considerable time was devoted to an extended discussion of various aspects of the national and District regulations governing student papers intended for submission in competition for District or national prizes. This discussion led to the adoption of the following two recommendations:

(1). That following the first paragraph on page 7 of the AIEE pamphlet of rules governing the award of national and District prizes (edition of January 1937, as amended January 23, 1940), a paragraph be inserted as follows:

"District executive committees shall have the power to fix the dates for closure and award of Branch-paper and graduate-student-paper prizes within its Districts. Unless action is taken by the District executive committee, the dates mentioned in the preceding paragraph of this section shall prevail." (These latter dates are specified as follows: ". . . subsequent to the period covered by the last previous award in the class and prior to the end of the last academic year, July 1 to June 30, inclusive.")

(2). That certain definite changes (specified in detail) be made in the rules governing the award of national and District prizes to provide a basis for the grading of Student papers for such prizes on a basis entirely separate and distinct from the basis used for the judging of regular AIEE technical program papers."

The stated purpose of the first item is "to recognize the diversity of the Student Branch program in the several Districts according to their individual conditions and to enable each District to schedule its prize competition much more effectively in its particular calendar of activity." The second proposal is intended "to recognize that the objective of Student papers differs

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Future AIEE Meetings

Pacific Coast Convention
Los Angeles, Calif., August 27–30, 1940

Middle Eastern District Meeting
Cincinnati, Ohio, October 9–11, 1940

Winter Convention
Philadelphia, Pa., January 27–31, 1941

Great Lakes District Meeting
Fort Wayne, Ind., April 1941

North Eastern District Meeting
Rochester, N. Y., May 1941

Summer Convention
Toronto, Can., June 16–20, 1941

from that of adult papers, and to provide a basis for the grading of the former which is more appropriate to its objective. It is not the primary purpose of Student papers to contribute to the technical advancement of the profession. They should constitute a vehicle for the training and stimulation of future contributors to the profession. To this end, greater emphasis on the written presentation and on the exercise of engineering thinking, are to be encouraged, rather than technical value."

These actions subsequently were endorsed and recommended to the board of directors at the closing session of the conference of officers, delegates, and members. At its Swampscott meeting, the board of directors referred these proposals to the AIEE committee on award of institute prizes for reports to the board later.

Among other topics discussed at some length, but without action, were the use of other than monetary awards for District prizes for student papers, and the question of publishing abstracts of District prize papers in ELECTRICAL ENGINEERING.

Reports of Technical Conferences

Six technical conferences were held in connection with the summer convention at Swampscott, Mass., June 24–28, 1940. Reports of five of these conferences follow. No report of the conference on load swings, held June 25, was available at publication time.

STANDARDS

This conference, held Tuesday afternoon, June 25, was planned as a continuation of the morning session on standards, with the special object of discussing the principles of short-time ratings of electrical apparatus. This subject is being studied by AIEE co-ordinating Committee 4 as a continuation of the program initiated at the January 1939 symposium on motor rating. As an outgrowth of the earlier meeting, AIEE Standards No. 1, entitled "General Principles Upon Which Temperature Limits Are Based in the Rating of Electrical Machinery and Apparatus" has now been completely revised and was made available for the first time at this Swampscott meeting.

Two informal papers were presented at the conference, both dealing with methods of rating welding apparatus. R. C. Freeman, who presented the first paper dealing with the rating of welding generators, stressed the importance of designing generators to meet actual customer needs, rather than to comply with an arbitrary short-time rating. In practice, a welding generator must deliver the required welding current under all operating conditions, but it does not need to have the cooling capacity that would be required for a continuous rating at the full current. Due to the intermittent character of hand welding, with delays for changing electrodes, readjusting the work, etc., the generator is idle for a considerable part of the time. Experience indicates, therefore, that actual loads very rarely exceed in severity a duty cycle consisting of alternate periods of 60 per cent time on and 40 per cent time off. Furthermore, the duration of each load cycle is so short that a continuous load equal to the rms equivalent of the duty cycle gives a fair representation of the heat-dissipating requirements.

For these reasons, the proposal was made that welding generators be rated on a 60 per cent duty cycle, or its practical equivalent of a 75 per cent service factor basis. This would require the generator to meet the standard temperature rise for the class of insulation used when operated continuously at 75 per cent of the nameplate current.

Mr. Freeman also presented data on the various methods of measuring temperature rise and stressed the difficulty of obtaining accurate measurements "on the fly" when the 30-minute test or other short-time heat run is required. He pointed out that the thermometer method is particularly inaccurate on short-time tests at high currents, which result in a considerable internal temperature drop through the insulation, and a material time lag of the thermometer behind the actual copper temperature. For these reasons, the proposed continuous test at the service factor rating will give a much more accurate and definite criterion of rating. In conclusion, he presented a tabulation of differences between the thermometer and the resistance method of temperature-rise measurement for several different American makes of welding generator, showing a spread of from 17 to 40 degrees between these two methods of measurement, as compared with 10 degrees recognized in the revised AIEE Standards No. 1. This evidence confirms the data given in Mr. Compton's paper presented at Scranton in October 1939 and that in Mr. Veinott's paper presented at the morning session, to the effect that the resistance method is preferable to the thermometer method for accurate tests, but that appreciably higher rise values must be permitted if present-day d-c machines are to be accepted on a resistance instead of a thermometer-rise basis.

A. U. Welch, who presented the second paper dealing with the rating of welding transformers, gave a careful analysis of various hand-welding duty cycles, and also reached the conclusion that a 60 per cent time on duty cycle gives the most satisfactory representation of the actual service requirements. In the case of a transformer, with its relatively low light-load losses, this duty cycle is simulated by a continuous heat run at 80 per cent of the rated current. Mr. Welch, therefore, proposed that a "service-factor rating" of 80 per cent be used for welding transformers in place of the present practice of short-time ratings, which do not represent actual continuous load, nor give a fair picture of the transformer's ability to meet the actual load requirements without overheating.

In the ensuing discussion, various views were expressed on alternative methods of short-time rating. On the one hand, the facts that temperature limits are common to all types of apparatus and that the all-day output of a machine is generally proportional to its continuous capacity, suggest that machines should be rated on the basis of continuous output at the limiting temperature. In this case, machines may be given some type of overload rating, expressing their reliable peak capacities. On the other hand, the rms method of evaluating duty-cycle loads was stressed as satisfactory for the great majority of all industrial applications, and the desirability of rating the apparatus in terms of its safe available output was shown. These ideas lead at once to the "service-factor rating" method, in which the nameplate rating indicates the always available capacity, while the service factor shows the percentage of the nameplate value which can be carried continuously within the standard temperature limits. The 115 per cent service factor now applied to all general-purpose motors is a case in point, and it was pointed out that the use of a service factor less than unity, as now proposed for welding apparatus, is merely an extension of present well-established practice. L. E. Hildebrand's paper "Duty Cycles and Motor Rating" (*AIEE Trans., vol. 58, 1939, p. 478–83*) was cited in support of this position.

Co-ordinating Committee 5, Basic Theories and Units. Reporting upon this subcommittee, which was appointed in April 1940, its chairman, Edward Bennett, presented for consideration a tentative statement of its functions and of the questions before it. (Copies of this report may be obtained from the chairman.) The function of the committee is to bring the resources of the Institute to the support of the movement looking toward agreements upon, and the use of, preferred systems of units. The work immediately before the committee will be informative in nature, designed to bring about a clearer and more widespread understanding of the following topics in the field of electrical units and standards:

(*a*). The principles governing the devising of comprehensive systems of units;

(*b*). The differing and conflicting purposes which are encountered in the devising of systems of units and in the defining of standards;

(*c*). The relative precision of alternative standardizing procedures and sequences;

(*d*). The questions closed by recent international decisions;

(*e*). The questions which are now pending.

Among the pending questions, the following call for consideration. Shall the rationalized or the unrationalized system of electrical units be designated as the preferred system? What further definitions or statements must be adopted in carrying out the standardizing procedure by which the electrical units and standards are to be derived from the mechanical units under the 1933 decision of the General Conference on Weights and Measures. This decision was to the effect that the electrical system of units is to be an absolute system in which the electrical units are derived from the mks mechanical units by assigning to the permeability of free space the value $\mu_0 = 10^{-7}$ in unrationalized units, or $\mu_0 = 4\pi 10^{-7}$ in rationalized units.

An organization meeting of co-ordinating committee 5 held Wednesday afternoon, June 26, gave further consideration to these questions and provided for the appointment of subcommittees to prepare memoranda or reports on a number of the questions.

Co-ordination of Current Ratings. The last part of the standards conference was devoted to a discussion of the proper co-ordination of current ratings of apparatus connected in series in the same circuit. R. E. Hellmund pointed out that when the load is continuous no particular problem exists as long as the continuous ratings of all devices and conductors are equal to or larger than the continuous load current. However, circuits with uniform loads are the exception rather than the rule and in most applications the load is intermittent or varying. A simple case of a motor with intermittent load was discussed for the purpose of illustration. With the load coming on and off, all the devices and conductors heat and cool alternately, but on account of their different sizes they usually have time constants varying over a wide range. This in turn leads to different degrees of heating during varying intermittent service. The usual practice with short-time and intermittently rated motors is to apply conductors having a continuous rating equal to the short-time rating of the motor. While this practice is safe, there is some question as to its economy. Curves were shown indicating that even though the time constant of the conductor is smaller than that of the motor, worthwhile economies can nevertheless be accomplished. Other curves were shown indicating that if the conductor has the same short-time rating as the motor, the heating of the conductor will be safe for all types of intermittent loads. Similar conditions apply to other series-connected apparatus, because as a rule all such apparatus has time constants smaller than that of the motor. It was stated that worthwhile economies very likely could be accomplished by further study and that particular attention should be given to thermal devices connected into the circuit for protecting either the motor or the conductors.

Subsequent discussion showed that very little is known about the effect of short-time heating of rubber used in wires and cables to temperatures above those considered safe for continuous service. Investigations along these lines seem desirable. It was suggested that a standards co-ordinating committee to study these questions in co-operation with other interested committees might be of assistance.

STATISTICAL METHODS

More than 100 attended the conference, two-thirds of which was devoted to the four scheduled papers, and the remaining third to general discussion.

The first paper was presented by H. F. Dodge, Bell Telephone Laboratories. He pointed out that any practical discussion of quality or its measurements must deal with variability. The quality of a finished product varies from unit to unit. No matter how great the effort or how refined the manufacturing process, no two units are exactly alike. For this reason, the quality of any mass of product, in terms of a single characteristic, is fundamentally a frequency distribution. Recognizing this fact, tolerance limits are set in terms of such a frequency variation. The magnitude of limits or their location is based entirely upon practical experience. By means of a sampling demonstrator, Mr. Dodge then showed what distributions look like and the ways in which they can be expected to vary under uniform conditions of sampling.

Next, control charts were presented which showed the improvement in apparatus obtained by analyzing variations in the product which fell outside of the established frequency diagram limits. In the use of these charts, it was pointed out that variations in the product beyond those expected nearly always indicated the presence of a source of variation large enough to be worth finding. On the other hand, variation of the product within the tolerance limits indicated there were no outstanding causes of trouble which were economical to eliminate. In the last part of his talk, the speaker pointed out that there is another method of controlling quality besides taking measurements on specific characteristics of the product. This method is that of setting tolerance limits on the "per cent defective." By means of sampling demonstrator typical variations in the "per cent defective" were shown. This concluded Mr. Dodge's talk and introduced that of J. A. Davidson, Western Electric Company.

First, Mr. Davidson demonstrated the magnitude of the inspection problem encountered in the manufacture of telephone apparatus. He showed the typical per-cent-rejection chart used for reference by Western Electric Company officials in controlling the quality of their apparatus. The left-hand side of this chart contained a typical per-cent-rejection record with dotted limit lines to define abnormal change in quality. On the right-hand side were data pertaining to the last point placed on the quality curve. The data showed the numbers of faults of various types and the demerit values applied to such faults. Lantern slides and special examples were then used to show the exact process of putting into operation statistical quality-control methods. It is to be noted that the defective material was divided into subgroups. In the subgroup which dealt with very serious quality defects the number of parts defective were multiplied by a constant which arbitrarily made the number defective appear larger than it really was. In the subgroup dealing with rejections of not quite so serious a character, the actual number defective was multiplied by a lesser factor. Hence, in the building up of the per-cent-rejection limits and other per-cent-rejection data, serious instances of poor quality were given much more weight than unimportant departures from good quality.

The demerits applied under this system are 100 demerits for very serious faults, 50 demerits for serious faults, 10 demerits for moderately serious faults, and 1 demerit for nonserious faults. This detailed analysis was very helpful to that part of the audience interested in the actual steps of applying quality control to a mass-production project.

Under the subject "Building up of Engineering Tolerances", R. E. Wareham, General Electric Company, showed the effects of adding together variations in structure. Using as an example the diameter of a bearing and shaft, it was shown that the least defective product could easily result in random selection of shafts to combine with random selection of bearings. This example demonstrated the fact that much engineering thought can well be given to the most economic way of assembling apparatus from the point of view of specified tolerance limits of the component parts and specified per-cent-acceptance limits of the final assembly.

Harold R. Bellinson, who was sent to the conference from the Aberdeen Proving Ground by the United States Army, discussed the aspects of designing experiments properly to get the maximum information for the minimum of data. First, Mr. Bellinson defined the conception of a population. It was pointed out that once the idea of a population is achieved, the necessary step is to set up an hypothesis that two sets of data come from the same population. An experiment is then made to determine whether they do not come from the same population. When the experiment yields a significant difference in the two sets of data, it can be concluded that there is little probability that they do come from the same population. Unless significant differences are found, the original hypothesis is considered to hold good.

Mr. Bellinson next emphasized the importance of sampling so as to obtain randomness. Randomness implies the lack of bias in the original observation and the fact that each observation will be completely independent of all other observations. Sensitivity of an experiment can be increased either by increasing the number of observations or by eliminating sources of error. Where economical and possible, control of test conditions is used in eliminating sources of errors; uncontrollable factors can best be handled by either randomizing or balancizing. If either of these is done, the sensitivity of the experiment may be changed and if such is the case, the experiment should be modified so that the final results will be returned to the desired degree of sensitivity.

Summing up all four papers, it may be said that they served as an excellent introduction of statistics into the fields of quality control, engineering, and research. Available for copying by members of the conference was a bibliography of reading matter on the subject of statistics. Furthermore, the members of the conference were presented by the American Standards Association with the May issue of "Industrial Standardization" containing J. Gaillard's review of Doctor W. A. Shewhart's latest book "Statistical Methods From the Viewpoint of Quality Control".

During the general discussion period, a number of interesting points were brought out. For example, under certain conditions, the sampling method of quality control may be more accurate than the 100 per cent inspection method. The application of statistics to quality control introduces the thought of improving the over-all quality of apparatus as compared to the typical inspection method which merely sorts the good units of apparatus from the bad. It was emphasized that men in the factory at the work bench react quickly and favorably to the idea of improvement in quality.

Doctor Shewhart stated that in research work the trend of the points toward limit lines can often be used as a useful indicator even before the limit-line boundaries are actually reached. It was brought out very clearly by P. L. Alger and Doctor Shewhart that statistical control plays a very large and relatively unexplored part in the field of purchasing specifications. During a period of unsettled world conditions, such as we are at present encountering, it is desirable to buy raw material with the minimum of delay and the maximum of economy. The statistical technique should greatly aid in achieving such efficiency. It was therefore unanimously recommended by a vote of those present that Mr. Alger convey to the

Standards Committee of the AIEE the recommendation that the committee undertake activities directed toward the introduction of the statistical technique in the control of quality of purchased material.

PRINCIPLES OF NONLINEAR ANALYSIS

The increasing importance of nonlinear problems in all phases of engineering research led to the organization of this technical conference by the committee on basic sciences, as a first attempt to present a rather comprehensive picture of the various mathematical methods available in nonlinear analysis. In order to guide the general discussion four prominent authors had prepared informal papers illustrating these methods.

Professor E. G. Keller of the University of Texas presented briefly six analytical methods, illustrating each one with a practical application taken from his experience with the General Electric Company. Starting with nonlinear celestial problems first solved by Euler, he ended with the most modern methods developed by the Russian, Galerkin. His electrical illustrations referred to problems of shunting of synchronous machines, transients in saturated iron circuits, declaration of rotors, and others, for which an extensive bibliography had been prepared in mimeographed form. Professor Keller also pointed out the difficulties to be encountered in actual solutions and called attention to the types of problems to which the different methods are particularly applicable.

A. Preisman of the RCA Institutes, New York, N. Y., explained the principles of graphical analysis, illustrating the method mainly with examples involving electron-tube circuits. Starting from simple resistive circuits, he then applied the method to electron-tube circuits with inductive and capacitive branches so that nonlinear differential equations resulted which he solved by a graphical step-by-step method, obtaining transient as well as steady state response.

Professor J. B. Scarborough of the United States Naval Academy presented the principles of the step-by-step numerical solution of nonlinear differential equations of the first and second order with the necessary checks to assure high accuracy, which is certainly one of the major advantages of numerical solutions. He illustrated the methods by means of three examples for which brief mimeographed tables had been prepared.

Professor S. H. Caldwell of the Massachusetts Institute of Technology finally gave a brief account of the principles involved in the use of the differential analyzer in the solution of differential equations of any order, linear or nonlinear. He illustrated the setting up of the differential analyzer for a nonlinear problem that Professor Scarborough had discussed. To show the wide applicability, Professor Caldwell chose four different problems, the first three with nonlinear resistance, inductance, capacitance, respectively, and the fourth with a combination of all three elements. He briefly indicated the main trouble with the present differential analyzer, particularly the amount of time needed in "putting in" the problem, and gave an informal preview of the principles of an improved analyzer which is in the state of construction.

The discussion was extremely interesting and brought out additional points, thus emphasizing the advantages of a free discussion on problems so definitely in the frontier of progress. The attendance of about 60 and the interest displayed were most gratifying and certainly dispelled any fear of bringing even most advanced topics before special groups such as usually gather for properly announced technical conferences.

TEST CODES

The technical conference on test codes was attended by approximately 30 people. The need for master test codes on general subjects which are common to different types of machines was discussed. The conference considered a report of the chairman of the subcommittee on d-c machines in regard to the status of the recently revised test code for d-c machines. The first draft of the preliminary test codes for single phase, a-c motor which has just been completed by the special subcommittee appointed for this purpose, was reviewed.

DIELECTRIC MEASUREMENTS IN THE FIELD

Over 60 members attended the conference on dielectric measurements in the field, which was sponsored by a subcommittee of the instruments and measurements committee. The success of the conference was due in large measure to the participation of many operating-company engineers who spoke freely on their experiences in the field. Seven prepared reports were presented as indicated by the following.

"A-C and D-C Measurements on Bushings, Armatures and Cables", by A. L. Brownlee, Commonwealth Edison Company. From test data in the form of dielectric power-factor-voltage curves, it is concluded that valuable information is obtained from measurements made at or above the rated voltage of the apparatus. Supplementary high potential tests are made before removing armatures from service. D-c measurements are as yet inconclusive, and further work is necessary.

"Power-Factor and Capacitance Measurements on Insulation of Distribution Transformers", by G. E. Quinn, Consolidated Edison Company of New York, Inc. Measurements of insulation power factor and capacity made during heating runs at 73 degrees centigrade are valuable in showing the influence of moisture. Temperature correction factors for the insulation properties are dependent on moisture content. The presence of ionization is shown by tests made at rated voltage.

"Insulation Tests by the Wattmeter Method", by F. C. Doble, Doble Engineering Company. Power-factor measurements at 10 kv by the wattmeter method were first made on bushings, and these tests were found to give a reliable indication of defective insulation. This method has been extended to transformers, circuit breakers, cables, and other equipment, and many thousands of pieces of apparatus are now being tested annually. Power-factor limits have been set up for questionable and defective insulation for various equipments. Localized insulation defects are determined by "hot-collar" tests which allow the application of high gradients to selected portions of the insulation.

"Insulation Testing in the Field", by H. R. Selfridge, Central Division, New England Power Company. Prior to 1930, low-voltage d-c resistance tests were successfully used to reveal the formation of creepage paths in type *SI* bushings. Insulation loss tests at 10 kv by the wattmeter method were next used to indicate the presence of moisture in condenser-type bushings. Yearly tests made on many bushings rated up to 110 kv have made possible a great reduction in outages. The tests are now also applied to metering equipment, transformers, and stack insulators.

"Field Tests on Oil Circuit Breakers", by G. L. A. Thomson, Public Service Electric and Gas Company (communicated). Oil circuit breakers are tested annually by means of two power-factor potentiometers operating at 10 kv and 70 cycles. The insulation losses are corrected to 40 degrees centigrade, and rejection values for breakers of various sizes have been selected. All indications showing poor oil, rods, insulators, bus supports, etc., are taken into account.

"A-C and D-C Measurements on Porcelain Pin-Type Insulators", by R. F. Field, General Radio Company. Insulation power factors and capacitances at very low frequencies are calculable by well-known methods from d-c resistance-time curves. From experimental data on insulators, it is shown that moisture increases the power factor and capacity in the low-frequency range and changes the temperature coefficient of power factor. Moisture in restricted parts of certain composite commercial insulations is not always harmful, however.

"Practical Aspects of Field Testing of Insulation by the Resistance-Time Method", by E. B. Curdts, The Narragansett Electric Company. Resistance-time tests were used to study the behavior of a transformer bank, one unit of which had been contaminated by water, flushed out, and put back into service. The conclusion is that such measurements provide a promising method to supplement the power-factor tests in indicating the presence of moisture and operating reliability.

In the subsequent informal discussion, I. W. Gross, American Gas and Electric Company reviewed briefly the results of his field testing as covered in papers published in *Electrical World* (1934) and ELECTRICAL ENGINEERING (1938). He said that each year the work is being extended profitably to additional types of electrical apparatus. C. F. Hill, Westinghouse Electric and Manufacturing Company, stated that the manufacturer's engineer is interested in field testing because he is sometimes invited to assist in field testing, and because he is responsible for the bench marks with which later field test results are compared. P. L. Betz, in a letter read by H. C. Louis, Consolidated Gas Electric Light and Power Company, recommended that more papers on field testing be published, and that complete circuit arrangements be described.

T. B. Whitson, James G. Biddle Company, pointed out that insulation containing moisture exhibits a more nearly constant resistance-time curve and a greater decrease in resistance with voltage increase than dry insulation. G. M. L. Sommerman, American Steel and Wire Company, stated that some insulations containing very large amounts of moisture are characterized by a decreasing resistivity-time curve in accordance with the early experiments of Evershed.

H. C. Hamilton, Boston Edison Company, pointed out that it would be very desirable to have a test method which would indicate defective insulation between turns of apparatus windings.

G. Keinath, consulting engineer, in a later communication, suggested that power-factor recording equipment operating at full line voltage be used in field tests, in view of the advantages of such a test method in indicating ionization.

The authors of the reports and discussions agreed to submit abstracts of their presentations for mimeographing and distribution to those who attended the conference and other interested members. In closing the conference, it was pointed out that plans were being made for the presentation of a symposium of papers on field testing of insulation in the near future.

Board of Directors Meets at Swampscott

The regular meeting of the AIEE board of directors was held at the New Ocean House, Swampscott, Mass., on June 27, 1940, during the annual summer convention of the Institute.

Chairman I. Melville Stein of the publication committee presented a report of the committee on the publication policy of the Institute and six specific recommendations for modifications. The board approved the recommendations of the publication committee as submitted. (The changes thus adopted are described on pages 331–2.)

Upon recommendation of the standards committee, the board approved for immediate publication the 1940 revision of AIEE Standards No. 45, "Recommended Practice for Electrical Installations on Shipboard," which had been prepared and submitted by the committee on applications to marine work.

Upon recommendation of the conference of Student Branch counselors and the conference of officers, delegates, and members, held during the 1940 summer convention, the board voted to change the period of time in which Enrolled Students may apply for admission to the Associate grade without payment of the entrance fee, to permit students graduating any time during the academic year (July 1 to June 30) to transfer until May 1 of the succeeding academic year with waiver of the entrance fee. This action was referred to the committee on constitution and bylaws for the necessary revision of the bylaws. The purpose of this change was "to extend to students graduating before the end of the academic year essentially the same period of grace now provided for June graduates".

Amendments to the rules governing the awards of national and District prizes of the Institute, which were recommended by the conference of Student Branch counselors and the conference of officers, delegates, and members, were referred to the committee on award of Institute prizes for report to the board of directors.

Recommendations adopted at the conference of officers, delegates, and members concerning procedure for transfer to the grade of Fellow in the Institute were referred to the board of examiners for consideration and report.

Upon request of the Charleston Section and recommendation of the Sections committee, the name of that Section was changed to "West Virginia Section".

The board approved the certificate of incorporation of the Engineering Societies Personnel Service, Inc., as a nonprofit membership corporation under the laws of the State of New York, authorized the termination of the joint agreement of 1923 with other societies under which the Engineering Societies Employment Service was established and the transfer of its activities to the new corporation, and authorized the president to appoint the AIEE representative on the board of directors of the Engineering Societies Personnel Service, Inc.

Resolutions expressing the board's appreciation of the effective services of the 1940 summer convention committee and its subcommittees, and of the women's entertainment committee, were adopted; also a resolution to the president of the New Ocean House in appreciation of the care taken for the comfort of those in attendance and for the excellent facilities provided for the convention events.

A motion was adopted, recording the board's appreciation of the effective services rendered during the past year by President F. Malcolm Farmer, who responded with an expression of his pleasure in the association with the members of the board.

Resolutions were adopted endorsing the defense preparedness program of the government and offering the services of the Institute in connection therewith, to be sent to the President of the United States. (See left.)

Other actions taken included the following:

Minutes of the meeting of the board of directors held on May 24, 1940, were approved.

A report was presented and approved of a meeting of the board of examiners held on June 13, 1940. Upon recommendation of the board of examiners, the following actions were taken: 2 applicants transferred to the grade of Fellow; 21 applicants transferred and 13 elected to the grade of Member; 107 elected to the grade of Associate; 64 Students were enrolled.

Expenditures in June, amounting to $20,521.37, were reported by the finance committee and approved.

Those present were:

President—F. Malcolm Farmer, New York, N. Y.

Vice-Presidents—T. F. Barton, New York, N. Y.; C. L. Dawes, Cambridge, Mass.; H. W. Hitchcock, Los Angeles, Calif.; A. H. Lovell, Ann Arbor, Mich.; F. R. Maxwell, Jr., University, Ala.; C. T. Sinclair, Pittsburgh, Pa.; J. M. Thomson, Toronto, Ont.

Directors—C. R. Beardsley, H. S. Osborne, New York, N. Y.; Mark Eldredge, Memphis, Tenn.; R. E. Hellmund, East Pittsburgh, Pa.; F. H. Lane, L. R. Mapes, Chicago, Ill.; K. B. McEachron, Pittsfield, Mass.; F. J. Meyer, Oklahoma City, Okla.; D. C. Prince, Schenectady, N. Y.; R. W. Sorensen, Pasadena, Calif.

National Treasurer—W. I. Slichter, New York, N. Y.

National Secretary—H. H. Henline, New York, N. Y.

Present by invitation: A. J. Hammond, president, American Engineering Council; A. W. Berresford, D. C. Jackson, Charles F. Scott, past presidents, AIEE; M. S. Coover, Everett S. Lee, R. G. Warner, officers-elect; I. Melville Stein, chairman, publication committee.

Regrets were received from:

Members of the board—W. H. Harrison and John C. Parker, past presidents, and A. L. Turner, vice-president.

Invited guests—Past Presidents C. A. Adams, H. P. Charlesworth, Frank B. Jewett, A. M. MacCutcheon, and C. E. Skinner.

Resolutions of the AIEE Board of Directors on National Defense

The board of directors of the American Institute of Electrical Engineers, at a meeting held on June 27, 1940, in connection with the 56th summer convention at Swampscott, Mass., unanimously passed the following Resolutions:

RESOLVED, That the President of the United States be advised that the American Institute of Electrical Engineers believes the principles upon which the government of the United States is founded should be preserved and that the Defense Preparedness Program be approved;

RESOLVED, That the President be advised that the American Institute of Electrical Engineers stands ready to aid in expediting in every possible way the carrying out of this program for the defense of our country;

RESOLVED, That the President be informed that the American Institute of Electrical Engineers and its members have already rendered service in connection with this Defense Preparedness Program through the American Engineering Council and other organizations that correlate all forms of engineering activities, and that this specific action is for the purpose of making known to those responsible for the planning and smooth functioning of the program that the Institute is wholeheartedly supporting it, and is ready and anxious to receive calls for any specific service that can be rendered by its 17,500 members or by any of its committees.

Respectfully submitted,
(*Signed*) F. Malcolm Farmer
President
H. H. Henline
Secretary

July 12, 1940

District

Middle Eastern District Meeting

Arrangements are rapidly nearing completion for the Middle Eastern District meeting and Student Branch convention, to be held in Cincinnati, Ohio, October 9–11, 1940. Meeting headquarters will be in the Hotel Netherland Plaza, located in the heart of the city.

ATTRACTIONS OF THE CITY

Cincinnati, known as "The Queen City," is of great beauty and interest. Its famous zoological gardens cover 57 acres of wooded grounds. Its art museum has acquired through the years a collection of old masters and modern paintings. Its university, home of Doctor Herman Schneider's well-known co-operative engineering course, is rated as the largest municipally owned university in the United States with an enrollment of nearly 13,000 students. The city is best known in many quarters for its music and the internationally famous symphony orchestra.

Cincinnati is known as the machine-tool capital of the world, its milling machines, grinders, planers, lathes, radial drills, etc., going to the four corners of the earth. It is noted as a radio center in the fields of manufacturing and broadcasting. Five broadcasting stations, including the former 500,000-watt super-power station WLW, are located in the vicinity. Cincinnati is rated first in the manufacture of soap and electrotypes and is the hub of a highly diversified industrial community of great importance in the present program of national defense. It has many points of interest for engineers.

TECHNICAL PROGRAM AND INSPECTION TRIPS

As the Cincinnati meeting is the only District meeting of the Institute scheduled for the fall of 1940, the local technical program committee, in co-operation with the national technical program committee, is providing a diversity of live topics calculated to appeal not only to the Sections of District 2 and the adjoining Districts but to many other members. Cincinnati is only overnight from all of the principal centers of Districts 2, 4, 5, and 7 and one day's drive only from most points in District 2.

An inspection trip on Thursday afternoon, October 10, will be taken to the great continuous strip mills and research laboratories of the American Rolling Mill Company at Middletown, Ohio, and on Friday afternoon, October 11, a trip will be made to the flood-proofed Columbia Station of the Cincinnati Gas and Electric Company, and a communications tour to the studio and transmitter of station WLW and the Crosley television station. More information on the technical program and a list of trips are scheduled for the September issue of ELECTRICAL ENGINEERING.

ENTERTAINMENT AND OTHER ACTIVITIES

Entertainment for all is being arranged. On Wednesday evening, October 9, while the men are occupied at a stag smoker, women guests will visit one of the principal radio studios to witness the presentation of a national feature program. A bridge luncheon for women is scheduled at noon on Wednesday, as well as special inspection trips on Thursday and Friday mornings to the new laboratories of the Kroger Food Foundation and to the Procter and Gamble Company, respectively. Thursday afternoon will be occupied by a musicale and tea in the attractive old colonial home of the late Charles Phelps Taft. This house is now an art museum under the supervision of the Cincinnati Institute of Fine Arts; the famous Taft collections of painting, French enamels, Italian majolica, and Chinese porcelain will be on display.

On Thursday evening is scheduled the banquet and an address by a nationally known speaker, and on Friday afternoon a sightseeing tour for members and their families to points of interest in the city and environs, including the principal parks, zoological gardens, art academy, Rookwood pottery, university, etc.

The Student Branch convention, at which Student members will find an attractive program devoted to their special interest, will be held in connection with the meeting. There will also be held the annual business meetings of the District executive committee and of the District committee on student activities.

Standards

Recommended Practice for Electrical Installations on Shipboard. A revised edition of AIEE Standards No. 45 "Recommended Practice for Electrical Installations on Shipboard (Marine Rules)" has just been issued. These marine recommendations have been drawn up to serve as a guide for the equipment of merchant vessels with electric apparatus for lighting, signaling, communication, power, and propulsion. They indicate what is considered good engineering practice with reference to the safety of the personnel and of the ship itself. This revised edition was developed and approved by the AIEE committee on applications to marine work in May and approved by the board of directors on June 27, 1940. Copies may be obtained from AIEE headquarters, 33 West 39th St., New York, N. Y., at a cost of $1.50 each, with usual 50 per cent discount to AIEE members on single copies only.

Measurement of Test Voltage in Dielectric Tests. A completely revised edition of AIEE Standards No. 4 "Measurement of Test Voltage in Dielectric Tests" was issued in June. The revisions include the latest developments in measurement of test voltages and wave shapes—puncture tests, flashover tests and voltage proof tests—the use of alternating current, direct current, and surge generators. An appendix is devoted to testing equipment and arrangement. An extensive bibliography is also included. Price 40 cents per copy; 50 per cent discount to members on single copies.

Electronic Devices. At the May 21 meeting of the standards committee a suggestion was approved which calls for the formulation of guiding standards for electronic devices. The joint subcommittee on electronics will be requested actively to undertake the project.

Vice-Chairman of Standards Committee. R. T. Henry, of the Buffalo, Niagara and Eastern Power Corporation, has accepted the appointment as vice-chairman of the AIEE standards committee

Abstracts

TECHNICAL PAPERS are previewed in this section as they become available in advance pamphlet form. Copies may be obtained on payment of price indicated to the AIEE order department, 33 West 39th Street, New York, N.Y.

Basic Sciences

40-108—Transient Analysis of Completely Transposed Multiconductor Transmission Lines; *Louis A. Pipes (A'37). 10¢.* Starting with the general equations of the completely transposed n-conductor transmission system expressed in matrix form, the equations are subjected to a similarity transformation. This transformation reduces the general equations to a set of n independent equations. These equations are then subjected to a Laplacian transformation and solved subject to the impression of arbitrary electromotive forces at a certain point of the lines. Expressions are obtained for the resulting traveling waves of voltage and current and the velocities of propagation are discussed. (This paper also was presented at the 1940 AIEE summer convention, Swampscott, Mass., June 22–26.)

Communication

40-136—Vario-Losser Circuits; *W. R. Bennett and S. Doba. 10¢.* Methods are given for the design of circuits using "varistor" elements to secure specified variations of loss as a function of input signal. The types of circuits include compressors and expandors using shunt, series, and lattice networks. Formulas for steady-state transmission and distortion in terms of varistor characteristics are developed.

Electrical Machinery

40-120—Some Acceleration Tests on Large Synchronous Pump Motors; *R. W. Ager (A'24). 10¢.* Acceleration tests on motors may yield very interesting and valuable information. These tests show the behavior of the motor in that region between zero speed and full speed through which each motor must pass every time it is started. The accelerating characteristics of a motor determine the margin by which that motor is able to start and bring its load up to speed in a reasonable length of time under the least favorable conditions which might be encountered. Acceleration tests may also be used in checking theories of operation, correctness of design constants, the presence of any peculiarities in the performance curves, and, in the case of induction and synchronous machines, any tendency to lock in at a subsynchronous speed. The main tests reported in this paper were made on the large synchronous pump motors used on the Metropolitan Water District aqueduct which is to supply Colorado River water to Southern California. The tests were performed in the field, after the motors had been installed, with the pumps connected, and with normal operating conditions existing.

40-135—A Generalized Equivalent Circuit in the Theory of Polyphase Commutator Motors; *W. B. Coulthard* (*M'34*). *10¢.* The novelty in this derivation of the theory of an individual motor by way of a generalized equivalent circuit lies not in the theory, but in the manner of its derivation. Incidental to his classroom lecture work, the author tired of the usual method of treating one motor per lecture, and undertook to derive the general characteristics from a basic principle.

40-130—Power-Factor Testing of Transformer Insulation; *J. B. Hodtum* (*M'26*). *10¢.* The term "power-factor testing" of insulation during the past several years has come into wide use. However, it is felt that dissipation factor is a better term because it is directly proportional to the product of its insulation loss and specific inductive capacitance and therefore simplifies the mathematics necessary when analyzing such tests. This paper points out a method for analyzing the results obtained from dissipation-factor tests of transformer insulation. Experimental data, obtained both from transformer tests extending over the past three years and from tests of sample insulation, indicate a definite relation between resistance and capacitance, with varying conditions of temperature and moisture. This relation furnishes a means for determining the condition of the insulation. The physical arrangement of the transformer windings and the type of test equipment used affect the tests and should be considered when interpreting results.

Instruments and Measurements

40-131—Behavior of Point Gaps at 60 cycles; *Jean V. Lebacqz* (*A'40*). *10¢.* This paper covers the result of extensive laboratory work. The results as summarized should be of interest and value to all those who are concerned with the flashover of insulation or of insulators.

40-128—Braking Magnets for Watt-Hour Meters; *I. F. Kinnard* (*M'28*) *and J. H. Goss* (*A'35*). *10¢.* It is the purpose of this article to discuss suitable test methods for determining characteristics of braking magnets for watt-hour meters and to review actual test data that have been obtained on magnets of various types and materials. A careful investigation is outlined showing the relationship of coercive force and the ability of the magnet to withstand demagnetizing fields. This investigation covers the demagnetizing effect of surge currents ranging from direct current to those approximating natural lightning. An attempt is made to formulate the requirements of an ideal watt-hour-meter braking magnet and to illustrate how a designer might make a logical choice from materials that are now available.

Power Generation

40-132—An Electrical Governor; *Frank I. Morgan* (*M'39*). *10¢.* The advantages obtained from the application of electrical methods of control to all classes of machinery suggested to inventors the idea of regulating the speed of prime movers by electrical means. Frequent attempts have been made to accomplish this result. Many of these governors were very ingenious, but for one reason or another they never came into general use. The electrical governor described in this paper is the result of several years' effort to develop a practical method of electrically controlling and regulating the speed of hydraulic turbines. The method utilizes a form of frequency meter which measures variations in the frequency (corresponding to changes in speed) of an alternating current supplied by the generator driven by the turbine to be governed. This meter, through suitable control equipment, moves a pilot valve, which in turn controls the operating engine that opens or closes the wicket gates of the turbine. This paper describes the equipment and gives an account of progress to date, including experience with an experimental installation made on a 3,000-horsepower turbine operating under a head of 55 feet.

Power Transmission and Distribution

40-133—Superposition Methods in Calculating Effects of Additions to Power Systems; *V. G. Rettig* (*A'32*). *10¢.* This paper outlines a group of methods that will permit calculation of all the common changes on power-system networks by superposition methods having as a basis the representation of loads as fixed currents. Investigation of the errors involved, and comparison with results obtained by assuming constant-impedance loads, when applied to the average power system networks in operation today, are included.

40-107—Shielding of Transmission Lines; *C. F. Wagner* (*M'37*), *G. D. McCann* (*A'38*), *and G. L. MacLane, Jr. 10¢.* Modern theories of direct stroke protection premise that the ground wires are so located as to intercept the stroke and provide perfect shielding. In spite of the fundamental importance of this question there still exists considerable doubt as to the correct position of the ground wires relative to the transmission conductors. Two avenues of approach are suggested for the attack of this question; first, the collection of statistical information regarding actual line performance, and second, the use of laboratory models. Line performance is, after all, the final criterion. However, it is difficult to isolate the shielding effect from other factors which may produce outage due to lightning. Studies with models eliminate this difficulty but always contain the element of doubt as to whether the laboratory conditions are sufficiently representative of actuality as to justify general conclusions. Perhaps the best course, that which is attempted in this paper, is to try both and co-ordinate the results so obtained. (This paper also was presented at the 1940 AIEE summer convention, Swampscott, Mass., June 22–26.)

40-126—Capacitors and Circuit Performance; *J. W. Butler* (*M'38*). *10¢.* This paper analyzes the performance of circuits with different types of capacitor applications. By circuit performance is meant: voltage regulation, voltage level, voltage control, load division, power factor, and energy losses. These points are analyzed and discussed as they are influenced by both series and shunt capacitors. The field of application of capacitors, in distribution and transmission circuits, is fairly well indicated in this paper, so far as circuit performance is concerned. The economic picture obviously will have its influence in a specific solution, and the information offered herein should make it easier for one to evaluate the results he expects to obtain in the way of circuit performance from the installation of capacitors.

Protective Devices

40-134—A Double-Break Oil- or Gas-Blast Power Fuse; *G. Leslie Hill* (*A'32*). *10¢.* The use of two use elements of different rating, in series, in a high-voltage fuse device is described in this paper. The two elements are placed in a tube and the tube is filled with an arc-extinguishing substance and sealed; one end with an expellable plug. In operation the lower rated element melts first on overcurrent and draws an arc; the energy from this arc is used to build up a pressure and forces the sealing plug out, which establishes a second arc. Then the pressure in the tube blasts the arc-extinguishing substance into the second arc and interrupts the circuit. Seven years' field experience has been obtained and is reported in this paper. The device has been applied on circuits up to 60 kv.

40-114—The Vertical-Flow Interrupter and Its Application to Oil-Poor Circuit Breakers; *B. P. Baker* (*A'38*). *10¢.* The historical background of the development of the vertical-flow interrupter for oil-poor circuit breakers is reviewed. A description of the interrupter and its theory of operation is given. The application of two of these interrupters to a 138-kv $1^1/_2$-million-kva oil-poor porcelain-clad circuit breaker is shown, together with laboratory test results. A review is given of important field tests on a 138-kv single-pole unit, tested line to ground on a large 220-kv operating system up to approximately $2^1/_4$ million three-phase kilovolt-amperes. Magnetic and cathode-ray oscillograms of these tests are shown.

40-127—An Improved A-C Pilot Wire Relay; *J. H. Neher* (*M'38*) *and A. J. McConnell* (*A'36*). *10¢.* This paper describes a relay system in which one standard relay element is used at each terminal. It is operative over a single telephone pair and gives full protection for any type of fault without the need for a potential supply. In addition, there is adequate insulation between the relay element and the pilot wires. The relay is of the current-product type, in which the energy required to operate the element is provided largely by the polarizing current; thus permitting the use of a relatively low energy level in the pilot-wire circuit. In many respects this system is similar to the "Translay" system used successfully in Europe for many years. Of its several improvements, an outstanding one is the use of the modern high-speed induction-cylinder relay element.

40-115—Displacement and Diffusion in Fluid-Flow Arc Extinction; *Joseph Slepian* (*F'27*). *10¢*. The displacement and diffusion theories of arc extinction in flowing fluids are defined and contrasted. The question as to the possibility according to hydrodynamical principles of the formation of the wedge required by the displacement theory is considered and decided in the negative. Photographic evidence is also found to contradict the displacement theory. How turbulence will multiply diffusive effects is considered, and an estimate of 100-fold multiplication is given for conditions existing in gas-blast breakers. This enhancement of diffusion by turbulence is found to make the diffusion theory adequate for accounting for the circuit-interrupting capacities of arcs in gas-blast circuit breakers.

40-129—Possibilities and Methods of Extending a Carrier-Current Relay Channel To Other Uses; *R. M. Smith* (*A'35*) *and S. L. Goldsborough* (*A'24*). *10¢*. The authors point out some of the possibilities and requirements incidental to the use of carrier-current relay channels for such other supplementary services as telemetering, signaling, supervisory control, remote tripping, and communication. The conclusion is that definite economies can be effected by using a relay carrier channel for the purposes, particularly if the simultaneous performance of different services is not essential and that these additional uses sometimes justify the expense of the relay carrier-current installation. Simultaneous performance of different functions can be provided by the use of additional equipment.

Personal • • •

G. E. Edgerton (M'29) colonel, Corps of Engineers, United States Army, has been appointed governor of the Panama Canal. He was born at Parkersville, Kans., April 17, 1887, received the degree of bachelor of science in mechanical engineering in 1904 and civil engineer in 1916 from Kansas State Agricultural College, and was graduated in 1908 from the United States Military Academy, in 1910 from the United States Army Engineering School, and in 1924 from the Army Command and General Staff School. He held the rank of lieutenant in the Corps of Engineers 1908–14; captain 1914–17; major 1917–31; lieutenant-colonel 1931–36; and colonel since 1936. He was an assistant engineer at the Panama Canal 1908–09; chief engineer, Alaska Road Commission, 1910–15; and from 1915 to 1919 was in the combat division of the Army in the Mexican expedition and the World War. During 1920–21 he was assistant to the chief of engineers, United States Army, in charge of supply and development of engineer equipment, and during 1921–23 was director of sales for the United States War Department. He went with the Federal Power Commission in 1924 as assistant chief engineer, and was chief engineer 1925–29. After a year as acting professor of civil military engineering at the United States Military Academy, West Point, N. Y., he became United States district engineer at Rock Island, Ill. He was made assistant to the chief of engineers, United States Army, in 1933, and in 1936 became engineer of maintenance at the Panama Canal. He is also a member of the American Society of Civil Engineers and other organizations.

T. S. Sloan (A'21, M'33) division manager of the Georgia Power Company at Columbus, Ga., and **L. M. Shadgett** (A'24, M'31) division manager at Athens, Ga., have been elected vice-presidents of the company, in accordance with a recent action of the board of directors by which all division managers were made vice-presidents. Mr. Sloan was born November 15, 1889, at Anderson, S. C., and attended Georgia School of Technology. He has been associated with the company and its predecessors since 1908 when he entered the operating department of the Georgia Railway and Power Company at Atlanta. In 1911 he went with the Central Georgia Power Company at Macon, and except for a year as superintendent of the Central Georgia Transmission Company, also at Macon, continued with that company until 1928. He was superintendent of substations 1913–23, and superintendent of operations 1923–28. He became division manager of the Georgia Power Company at Rome, Ga., in 1928, and was transferred to Columbus in 1937. Mr. Shadgett, a native (1899) of Adelaide, South Australia, graduated in mechanical and electrical engineering in 1921 from the South Australian School of Mines and Industries and the University of Adelaide. He was an engineer with the Adelaide Electrical Supply Company 1921–24, and from 1924 to 1928 was with the Alabama Power Company, Birmingham, as engineer and division superintendent. He has been with the Georgia Power Company since 1928, first as superintendent of wholesale operations and for the past three years as Athens division superintendent. He is a past chairman of the Georgia Section.

H. S. Foley (A'07, M'12) formerly vice-president and general manager of the Compania Colombiana de Electricidad, Barranquila, Colombia, has founded Motores Limitada, Bogota, Colombia, to distribute power machinery in Colombia for Westinghouse and other companies. Born January 21, 1884, at Kingman, Kans., he secured his technical training by correspondence courses. In 1900 he entered the employ of the Mexican Central Railroad Company as assistant electrician, and in 1904 went with the Mexican Light and Power Company, Mexico City, as foreman on transmission line construction, later becoming superintendent. He continued in Mexico until 1914, during the last four years serving also as superintendent of overhead trolley construction for Mexican Trainways Company. From 1914 to 1916 he was superintendent of distribution for the Ebro Irrigation and Power Company, Barcelona, Spain, and in 1916 became purchasing engineer in New York, N. Y., for the Compagnie Générale d'Électricité, Paris, France. Four years later he was appointed chief engineer of the Compania Hidroelectrica é Irrigadora del Chapala, Guadalajara, Mexico, and several years later became general manager of the Empressa Electrica del Ecuador, Inc., Guayaquil, Ecuador, of which he was subsequently appointed vice-president. He had been vice-president and general manager of the Colombia company since 1929.

M. F. Gill (A'14, M'33) has been elected president and general manager of the Kansas Gas and Electric Company, Wichita. Born at Paris, Tex., October 4, 1888, he received the degree of electrical engineer at the University of Texas in 1910. He was a student engineer with the General Electric Company, Schenectady, N. Y., 1910–12, returning to Texas in 1913 as resident engineer for the Texas Power and Light Company, Dallas. He continued with the company until 1917, becoming office engineer, and assistant chief engineer. After brief periods with the Stone and Webster Engineering Corporation, the United States Army, and the Phoenix Utility Company, he became assistant manager in 1919, and later manager, of the Texas Electric Service Company, Brackenridge and Eastland. He continued as manager, having charge of utility operation, engineering, and construction, until 1928, when he became general superintendent of the Phoenix Utility Company at Allentown, Pa. In 1935 he became co-ordinator for the Pennsylvania Power and Light Company, at Allentown, and in 1937 went to Kansas Gas and Electric as assistant to the president.

C. E. Ide (A'16, M'38) has been elected president of the East Tennessee Light and Power Company, Bristol, Tenn. He was born February 4, 1892, at Brayton, Iowa, and received the degree of bachelor of science in electrical engineering from Iowa State College in 1914. He has been associated with utility properties in the Cities Service system ever since, having been with the Denver (Colo.) Gas and Electric Light Company 1914–15; the Toledo (Ohio) Railways and Light Company 1915–16; statistical engineer in the New York, N. Y., office of Henry L. Doherty and Company, 1916–17; and with the Meridian (Miss.) Light and Railway Company, 1917–18. During the World War he was a member of the science and research division of the Signal Corps of the United States Army, returning to Henry L. Doherty and Company for the next eight years. He became vice-president and general manager of the East Tennessee Light and Power Company in 1927, and the following year assumed the same positions with the Tennessee Eastern Electric Company, Bristol. He was president of the Southeastern Electric Exchange 1939–40.

T. G. Miller (A'16) retired July 1, 1940, as vice-president in charge of the long-lines department of the American Telephone and Telegraph Company, New York, N. Y. Born June 22, 1880, at Sandusky, Ohio, he studied mechanical engineering at Massachusetts Institute of Technology. After leaving college because of illness, he was employed by the Lunkenheimer Company, Cincinnati, Ohio, for a time and later spent several years in railroad work in the Southwestern United States and Mexico. He entered the long-lines department of the American Telephone and Telegraph Company in New York in 1904, and in 1906 was made district supervisor of line maintenance at Atlanta, Ga. He returned to New York in 1907 and held various positions in the general office until 1913. From 1913 to 1919 he was division plant superintendent at Chicago, Ill., returning to New York as acting general plant superintendent. He became general plant manager in 1920, general manager in 1924, and vice-president in charge of the department in 1930.

C. L. Proctor (A'08) has been elected president of the Toledo (Ohio) Edison Company. Born in Charlotte County, Va., February 3, 1880, he received the degrees of bachelor of science in 1902 and mechanical engineer in 1903 from Virginia Military Institute. Following graduation he entered the test course of the General Electric Company at Schenectady, N. Y., and two years later was transferred to the railway department. He became general superintendent of the Athens (Ga.) Railway and Electric Company in 1908, continuing until 1915, when he became sales manager of the Empire District Electric Company, Joplin, Mo. He was vice-president and general manager of the Danbury and Bethel Gas and Electric Light Company, Danbury, Conn., 1918–19, returning to the Empire District company in that capacity in 1919. He went to Toledo Edison in 1925 as vice-president and general manager, continuing in that position until his present appointment. He was made a director of Cities Service Power and Light Company in 1939.

C. F. Craig (M'27) general manager, long-lines department, American Telephone and Telegraph Company, New York, N. Y., has been elected vice-president in charge of the department. Born April 6, 1893, at Rich Hill, Mo., he received the degree of bachelor of science in electrical engineering from the University of Missouri in 1913. The same year he entered the employ of the American Telephone and Telegraph Company at St. Louis, Mo., as an equipment attendant. He was engaged in cost studies and outside plant engineering there and at Kansas City until 1918, when he was made district plant chief (later superintendent) at St. Louis. In 1922 he was transferred to New York, N. Y., as plant accountant, becoming construction supervisor in 1923. He was sent to Atlanta, Ga., in 1925 as division plant superintendent, returning to New York in 1927 as special representative in the general department. He was made general manager of the long-lines department in 1933.

L. O. Ripley (A'05) has retired as president of the Kansas Gas and Electric Company, Wichita, but will continue with the company as director in a consulting capacity. Born April 20, 1877, at Laurens, N. Y., he was graduated from Union College in electrical engineering in 1900. After graduation he was employed by the Clark Estates and by the Clinton Mills Power Company, both at Cooperstown, N. Y., and as superintendent of construction of the municipal power plant at Marathon, N. Y. In 1903 he became superintendent of the light and power department of the Schenectady (N. Y.) Railway Company, and when the Schenectady Illuminating Company was separated from the railway company in 1905 he became manager of the latter. He went to Wichita when the Kansas Gas and Electric Company was organized, in 1909, as vice-president, and has been chief operating executive ever since.

W. E. Groves (A'37) has been awarded the AIEE District 9 prize for Branch paper for 1939 jointly with Opal Cummins for their paper "Water-Cooled Radio-Frequency Amplifier With Grounded Anodes". The paper also received the award of the Utah Section for 1939. A native (1907) of Fort Worth, Tex., he received the degree of bachelor of arts from the University of Utah in 1936, and was carrying on further study there at the time the paper was written. He was a radio net operator for the United States War Department 1927–29 and is a graduate of the Army Signal School. Since 1929, except for a short period as chief engineer of station KLO, Ogden, Utah, he has been employed by station KSL, Salt Lake City, Utah, of which he is now chief engineer. He is also a member of the Institute of Radio Engineers.

G. H. Calkins (A'07, M'29) retired July 1, 1940, as manager of the Buffalo, N. Y., office of the General Electric Company. Born September 29, 1873, at New England, Ohio, he received the degree of electrical engineer in mechanical engineering from Ohio State University in 1895. He was a fellow and instructor in the department of physics at Ohio State, Columbus, 1895–96, and was also engaged in railway construction for the Degnon Construction Company, Columbus, and in consulting engineering, before going with General Electric in 1899. He was at Schenectady, N. Y., in the test course, and production and sales departments until 1906, when he became manager of the New Haven office of the company. Since 1907 he has been manager of the Buffalo office.

Nejat Atsan (A'40) has received the AIEE District 7 prize for graduate paper for 1939 for his paper "A Method of Line-Voltage Control". Born February 23, 1905, at Istanbul, Turkey, he studied marine engineering at the Turkish Naval Academy, and received the degree of bachelor of science from the Ingenieur Academie, Oldenburg, Germany, in 1930, and that of master of science in electrical engineering from the University of Missouri in 1939. He served as a first lieutenant in the Turkish war fleet from 1930 to 1934, and was a wireless engineer 1934–37 for the Turkish Ministry of Communication at Ankara, Turkey, for which he is now an electrical and wireless engineer. He is also a member of the Verein Deutscher Elektrotechniker.

T. E. Curtis (A'40) has received the AIEE District 8 prize for Branch paper for 1939 for his paper "Compound Frequency Control of Power Systems". Born June 26, 1917, at Long Beach, Calif., he received the degree of bachelor of science in electrical engineering from the University of California in 1939. Since graduation he has been employed as electric underground estimator by the Pacific Gas and Electric Company, at Oakland, Calif. He received the award of the San Francisco Section in 1939 for prize-winning paper presented at a joint meeting of Branches in that Section. He is also a member of Sigma Xi, Tau Beta Pi, and Eta Kappa Nu.

J. W. McNall (A'38) research engineer in the lamp division of the Westinghouse Electric and Manufacturing Company at Bloomfield, N. J., has been awarded the B. G. Lamme graduate scholarship for 1940–41. He will study electronic physics. Born October 19, 1914, at Cleveland, Ohio, he received the degree of bachelor of science from Case School of Applied Science in 1936, and has done some graduate work at the University of Pittsburgh. Following his graduation he entered the research laboratories of the Westinghouse company at East Pittsburgh, and in 1938 was transferred to the lamp division. He is a member of Tau Beta Pi and Sigma Xi.

Wills Maclachlan (A'08, F'21) consulting engineer, Toronto, Ont., Can., has been elected president of the Royal Canadian Institute. He has been particularly concerned with accident prevention and industrial relations in his consulting practice, serving the Electrical Employers Association of Ontario, Hydroelectric Power Commission of Ontario, Toronto Hydroelectric System, and other public and private organizations. He has been chairman of the AIEE committee on safety since 1937, was a vice-president (1919–20), and has been active on other committees of the AIEE and in other organizations in the United States and Canada.

W. D. Howell (A'38) industrial power engineer, Pacific Gas and Electric Company, San Francisco, Calif., has been awarded an Alfred P. Sloan Foundation fellowship for a year's graduate study in the graduate school of business administration, Massachusetts Institute of Technology, Cambridge. He has been given leave of absence from Pacific Gas and Electric for that period. Mr. Howell, who received the degree of bachelor of science from the University of California in 1932, was recently transferred to San Francisco after being with the East Bay sales office of Pacific Gas and Electric at Oakland, Calif., since 1926.

V. G. Rettig (A'32) electrical engineer, Cincinnati Gas and Electric Company, Cincinnati, Ohio, has been awarded first prize in the James H. McGraw prizes of the

Edison Electric Institute for the three most meritorious papers on engineering or technical subjects related to the electrical industry, for his paper entitled "Basis for a Program of Capacitor Additions on a Growing Distribution System". Mr. Rettig, who received the degree of electrical engineer at the University of Cincinnati in 1930, has been with the Cincinnati utility in various capacities since 1928. He is a member of Eta Kappa Nu and Tau Beta Pi.

D. S. Snell (A'24) electrical engineer, a-c turbine engineering department, General Electric Company, Schenectady, N. Y., has been awarded AIEE District 1 prize for best paper for 1939 for his paper "The Hydrogen-Cooled Turbine Generator". Mr. Snell who holds the degrees of bachelor of science (1919) and master of science (1921) in electrical engineering from Union College, Schenectady, N. Y., was an instructor there 1921–22. He had previously spent 18 months in the testing department of General Electric, and since 1922 has been with that company continuously.

H. D. Green (M'35) with J. J. Joy and F. P. Kuhl received the cash prize accompanying the Augustus D. Curtis award of the Edison Electric Institute. The award, which is for contributions to the advancement of artificial illumination of public or commercial buildings, was presented in 1940 to the Consolidated Edison Company of New York, Inc., New York, N. Y., for a relighting installation in its mechanical engineering drafting room (*see EE, Feb. '40, p. 68–9*). Mr. Green, an assistant division engineer for the company, was honored as one of the individuals responsible for the achievement.

H. R. Sills (A'24, M'31) has received the AIEE District 10 prize for best paper for 1939 for his paper "Vertical Shaft Generators" (*EE, Dec. '39, p. 469–79*). A native (1900) of Kingston, Ont., Can., he received the degree of bachelor of science from Queens University in 1921. Following graduation he entered the test course of the Canadian General Electric Company, Ltd., at Peterboro, Ont., and since 1925 has been assistant engineer in charge of design of large generators and special machines. He received the District 10 prize for initial paper in 1928.

A. M. Doyle (A'37) has received the AIEE District 10 prize for initial paper for 1939 for his paper "Lightning Protection for Power Transmission Systems". Born June 15, 1908, at Winnipeg, Man., Can., he received the degree of bachelor of science in electrical engineering from the University of Manitoba in 1928. He entered the employ of the Canadian General Electric Company, Ltd., as a student in the test course, was later transferred to the transformer design department, and since 1930 has been a transformer sales engineer in the Toronto office of the company.

Opal Y. Cummins (membership application pending) has been awarded the AIEE District 9 prize for Branch paper for 1939 jointly with W. E. Groves for their paper "Water-Cooled Radio-Frequency Amplifier With Grounded Anodes". The paper also received the 1939 award of the Utah Section. Born at Salt Lake City, Utah, September 2, 1919, Miss Cummins received the degree of bachelor of science in electrical engineering from the University of Utah in 1939, and is at present employed as a draftsman by the International Smelting and Refining Company, Salt Lake City.

A. E. Harrison (A'39) has received the AIEE District 8 prize for graduate paper for 1939 for his paper "Ionization Time of Thyratrons". A native (1908) of San Luis Obispo, Calif., he received the degree of bachelor of science from the University of California in 1936 and that of master of science from California Institute of Technology in 1937. He was a teaching fellow at the latter institution 1937–39, and is at present employed by the Sperry Gyroscope Company, San Carlos, Calif.

H. N. Steen (A'31) has received the AIEE District 9 prizes for best paper and initial paper for 1939 for his paper "A Three-Element Cathode-Ray Oscillograph". A native (1906) of Seattle, Wash., he received the degree of bachelor of science in electrical engineering from the University of Washington. He has been employed as a laboratory assistant at the University of Washington, Seattle; as assistant engineer by the Seattle Cedar Lumber Manufacturing Company; and is at present engineer for the Instrument Laboratory, Inc., Seattle.

W. M. Goodhue (A'31) has received honorable mention in the AIEE District 1 prize for best paper for 1939 for his paper "The Rectifier Calculus". Mr. Goodhue, who received the degrees of bachelor of science (1928) and master of science (1929) from Harvard University, has been associated with the department of electrical engineering there since 1929, first as assistant and then as instructor.

P. J. Reifschneider (Enrolled Student) has received the AIEE District 3 prize for Branch paper for 1939 for his paper "An Electronic Voltage Regulator for an Alternator". Born in Brooklyn, N. Y., September 30, 1917, he received the degree of bachelor of electrical engineering from the Polytechnic Institute of Brooklyn in 1939, and is at present studying for his master's degree at the same institution.

Conrad Creim (A'34) has been appointed chief electrical and mechanical engineer for Jahn-Bressi-Bevanda Constructors, Inc., Los Angeles, Calif., on the Tucumcari tunnel project at Conchas Dam, New Mexico. Since graduation from the University of California in 1933 he had been in the employ of the Los Angeles Metropolitan Water District.

Robert B. Bonney (Enrolled Student) has received the AIEE District 7 prize for Branch paper for 1939 for his paper "Directional Antennas for Broadcast Stations". A native of Cimarron, N. Mex., he was at that time a student in electrical engineering at the University of New Mexico.

C. S. Cole (A'30, M'35) has been transferred from the Buffalo Niagara Electric Corporation, Niagara Falls, N. Y., to the Niagara Lockport and Ontario Power Company at Medina, N. Y. He has been employed by operating companies of the Niagara Hudson System since 1934, in charge of changeover programs in western New York State in connection with the change in frequency from 25 to 60 cycles.

C. E. Boulson (A'40) has been employed by the Missouri Electric Power Company, Marshfield, as electrical engineer in charge of distribution load studies. Since graduating from the Missouri School of Mines in 1939 he had been with Jay Samuel Hartt, Madison, Wis., on inventory work connecting with setting up a uniform system of accounts for Missouri Electric.

Paul Lebenbaum, Jr. (A'37) formerly supervisor of the electrical engineering section of the General Electric Company's advanced course in engineering, at Schenectady, N. Y., has been transferred to the motor engineering department of the company, at Lynn, Mass.

E. R. Stauffacher (A'15, M'26) has been transferred from the power engineering division of the commercial department of the Southern California Edison Company, Ltd., Los Angeles, Calif., to general engineering work in the operating department, with the title of electrical engineer.

R. A. Fuller (A'29) formerly in the commercial refrigeration department of the General Electric Company, Fort Wayne, Ind., has been appointed application engineer in commercial refrigeration and air conditioning, with headquarters at the company's River Works, West Lynn, Mass.

R. M. Darrin (A'28, M'34) formerly in charge of central-station sales for the Buffalo office of the General Electric Company, has been made manager of the Syracuse office. He has been with the company since 1919.

G. B. Hoadley (A'35) formerly instructor in electrical engineering, Massachusetts Institute of Technology, Cambridge, has been appointed assistant professor of electrical engineering, Polytechnic Institute of Brooklyn, N. Y.

E. F. King (A'37) formerly engineer in the radiant-heat division, C. M. Hall Lamp Company, Detroit, Mich., has become an instructor in electricity and radio at the Boeing School of Aeronautics, Oakland, Calif.

P. L. Bellaschi (A'29, F'40) section engineer, transformer engineering department, Westinghouse Electric and Manufacturing Company, Sharon, Pa., recently was awarded the honorary degree of doctor of science by Washington and Jefferson College.

W. G. Robertson (A'24, M'38) formerly assistant valuation engineer, State Corporation Commission of Virginia, Richmond, is now electrical engineer for the Clifton Forge Waynesboro (Va.) Telephone Company.

L. G. Snyder (A'23, M'35) formerly sales manager, Landis and Gyr, New York, N. Y., is now sales manager in charge of central station sales, Metropolitan Device Corporation, Brooklyn, N. Y.

C. E. Creccy (A'15, M'27) formerly plant extensions engineer, Chesapeake and Potomac Telephone Company of Virginia, Richmond, has been appointed transmission and outside plant engineer.

F. A. Rechif (A'38) formerly assistant operator, geophysical department, Continental Oil Company, Ponca City, Okla., is now employed as engineer by the Mott-Smith Corporation, Houston, Tex.

S. P. Shelton (A'37) formerly with the City of Los Angeles (Calif.) Department of Water and Power, is now with the Public Works Division of the Puget Sound Navy Yard, Bremerton, Wash.

G. E. Hulse (M'22) chief engineer, the Safety Car Heating and Lighting Company, New Haven, Conn., has been nominated a manager of the American Society of Mechanical Engineers for 1941.

E. J. Barrett (A'39) formerly serviceman, Sierra Pacific Power Company, Reno, Nev., has been made draftsman in the engineering department of the company.

Obituary

Jacques W. Wegrin (A'29) consulting engineer, New York, N. Y., died November 26, 1939, according to information just received at Institute headquarters. He was born December 25, 1883, at Kreutzburg, then in Russia, and received his technical training at the College of Engineering, Cothen, Germany. He also studied at the University of California. He was an electrical engineer for H. Rouland Company, Berlin, Germany, 1905–06, and superintendent of a power plant and mountain railway at Dresden, Germany, 1907–08. In 1908 he organized a power and light company at Riga, Russia, which he continued to manage until 1912, also handling Russian sales for two German equipment companies. From 1912 to 1915 he was sales engineer in Russia for Landis and Gyr, Switzerland. After coming to the United States he wrote for German and Russian trade magazines, and beginning in 1922 was associated as consulting engineer with various Russian trade organizations, including the Amtorg Trading Corporation.

David Ittin (A'30) shift engineer, Haifa Power Station, Palestine Electric Corporation, Ltd., Haifa, Palestine, died August 21, 1939, according to information just received at Institute headquarters. He was born December 29, 1906, at what is now Stalingrad, USSR, and received the degree of bachelor of science in electrical engineering at Armour Institute of Technology in 1928. After a year in the test course at General Electric Company, Schenectady, N. Y., he was transferred to the commercial engineering department of International General Electric Company. He was later employed for several years as inspector for the Brooklyn (N. Y.) Edison Company, before going to Haifa as engineer for the Palestine Electric Corporation.

Harry William Motter (A'18, M'31) sales and consulting engineer, York, Pa., died May 30, 1940. He was born October 14, 1889, at York, Pa., and was graduated in electrical engineering at Lehigh University in 1913. From 1913 to 1919 he was engaged as electrical engineer in charge of the electrical department of George F. Motter's Sons, York. In 1919 he organized his own business as sales and consulting engineer, serving industrial and utility companies, and acting as district representative for various electrical manufacturing firms. He continued in this practice until his death.

Gerald C. Young (A'37) engineer, Abington Electric Company, Clarks Summit, Pa., died June 23, 1940. He was born May 28, 1904, at Cumberland, Md., and received the degree of bachelor of science in electrical engineering from Virginia Polytechnic Institute in 1926. Following graduation he entered the cadet engineering course of the Chester Valley Electric Company, Coatesville, Pa. He had been with the Abington Electric Company since 1928. He was also a member of the Pennsylvania Electric Association.

Ralph Maynard Towne (A'36) consulting engineer, Tacoma, Wash., died May 24, 1940. He was born April 1, 1912, at Salt Lake City, Utah, and received the degree of bachelor of science in electrical engineering from the University of Washington in 1935. He had been engaged in design and construction of utility plants and lines and in REA construction work since his graduation. He was also a member of Tau Beta Pi and Sigma Xi.

Membership

Recommended for Transfer

The board of examiners, at its meeting on July 25, 1940, recommended the following members for transfer to the grade of membership indicated. Any objection to these transfers should be filed at once with the national secretary.

To Grade of Member

Appleby, H. A., assistant signal engineer, Atchison, Topeka and Santa Fe Railway Company, Amarillo, Tex.
Collens, C. L., president, Reliance Electric and Engineering Company, Cleveland, Ohio.
Craig, H. M., field engineer, Bell Telephone Laboratories, Chicago, Ill.
DuMont, P. J., assistant port engineer, Grace Lines, Inc., New York, N. Y.
Dyer, J. M., transmission engineer, Southwestern Light and Power Company, Lawton, Okla.
Loewe, Robert, electrical engineer, Commonwealth and Southern Corporation, Jackson, Mich.
Murdock, H. E., division superintendent, Montana Power Company, Bozeman
Paxton, Robert, managing engineer, General Electric Company, Philadelphia, Pa.
Pearce, C. T., Middle Atlantic engineering manager, Westinghouse Electric and Manufacturing Company, Philadelphia, Pa.
Pickslay, Wm. M., assistant engineer, Allis-Chalmers Manufacturing Company, Milwaukee, Wis.
Potter, E. A., member of technical staff, Bell Telephone Laboratories, New York, N. Y.
Rick, G. D., assistant power supervisor, Public Service Company of Northern Illinois, Wheaton, Ill.
Stanley, F. L., plant extension engineer, Indiana Bell Telephone Company, Indianapolis, Ind.
Straus, F. N., electrical and mechanical engineer, Austin Company, Cleveland, Ohio.
Troxel, F. D., electrical engineer, Sargent and Lundy, Inc., Chicago, Ill.
Worth, D. G., associate electrical engineer, Bonneville Power Administration, Portland, Ore.
Zane, R. B., electrical engineer, The Okonite Company, Chicago, Ill.

17 to Grade of Member

Applications for Election

Applications have been received at headquarters from the following candidates for election to membership in the Institute. Names of applicants in the United States and Canada are arranged by geographical Districts. If the applicant has applied for direct admission to a grade higher than Associate, the grade follows immediately after the name. Any member objecting to the election of any of these candidates should so inform the national secretary before August 31, 1940, or October 31, 1940, if the applicant resides outside of the United States or Canada.

United States and Canada

1. North Eastern

Herman, W. P. (Member), Electrix Corporation, Pawtucket, R. I.
Nims, P. T., American Bosch Corporation, Springfield, Mass.

2. Middle Eastern

Brown, C. E., Jr., The Okonite Company, Washington, D. C.
Johnson, P. S. (Member), Union Switch and Signal Company, Swissvale, Pa.
Muhovich, M. R., Westinghouse Electric and Manufacturing Company, Sharon, Pa.

3. New York City

Marculescu, G. B., 728 West 181 Street, New York, N. Y.
Martianov, V., Amtorg Trading Corporation, New York, N. Y.
Trucksess, D. E. (Member), Bell Telephone Laboratories, New York, N. Y.

4. Southern

Bedford, E. M., Jr., Commonwealth and Southern Corporation, Birmingham, Ala.
Cahoon, W. H. (Member), Tennessee Valley Authority, Knoxville, Tenn.
Slater, H. A., Tennessee Valley Authority, Chattanooga, Tenn.
Taylor, E. T., Tennessee Valley Authority, Wilson Dam, Ala.
Wood, B. T., Mathieson Alkali Works, Inc., Lake Charles, La.

5. Great Lakes

Bailey, T. G., Commonwealth Edison Company, Chicago, Ill.
Bernthal, V. O., Public Service Company of Northern Illinois, Joliet, Ill.
Browell, E. G., Illinois Valley Electric Co-operative, Princeton, Ill.
Grinstead, C. E., General Motors Research Laboratories, Detroit, Mich.
Riche, A. L. (Member), Micro Switch Corporation, Freeport, Ill.

6. North Central

Tilden, W. C., Loup River Public Power District, Columbus, Nebr.

7. South West

Raushenberger, E. J., A. Y. Taylor and Company, Clayton, Mo.
Robb, J. D., Geiger's Plumbing and Electrical Shop, Boonville, Mo.

9. North West

Cummins, O. Y., International Smelting and Refining Company, Salt Lake City, Utah.
Rorberg, C. E., Washington Water Power Company, Spokane.

10. Canada

Taylor, K. D., Hydro Electric Power Commission of Ontario, Simcoe.
Wighton, J. J., Canadian Broadcasting Corporation, Vancouver, B. C.

Total, United States and Canada, 25

Elsewhere

Capwell, G. L. (Member), Empresa Electrica Del Ecuador, Inc., Guayaquil, Ecuador.
Clifford, A. E. (Member), Harland Engineering Company, Alloa, Scotland.
Han, V. K., Voon Radio Service, Penang, Straits Settlements.
Teal, A. E. (Member), Public Works Department, Gurdaspur, Punjab, India.
Venkataraman, M. K. R., care of Imperial Bank of India, London, E.C. 2, England.

Total, elsewhere, 5